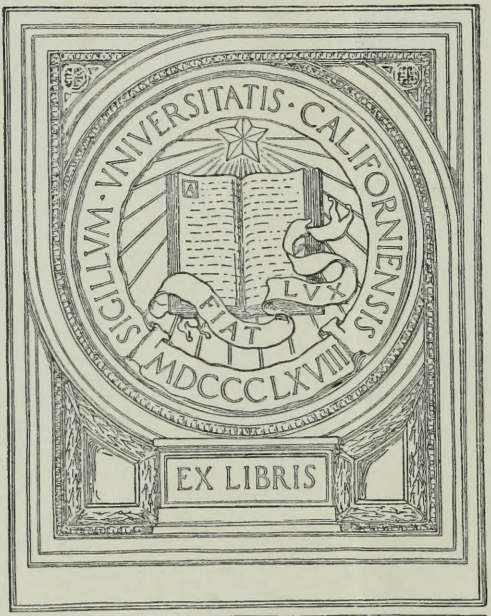
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THIS WORK

Is respectfully Dedicated

TO THE

MEDICAL PROFESSION OF THE UNITED STATES,

BY THEIR OBEDIENT, HUMBLE SERVANT,

THE AUTHOR.

35[illegible]

PREFACE TO THE FIRST EDITION.

The Author of this work has endeavoured to keep before him the difficult objects of adapting it to the student in medicine and to the more advanced. For the advantage of the former, therefore, he has aimed at such method as he might command, and such illustration as might not seem irksome to the latter. With a view to the former, also, he has endeavoured to indicate the intimate manner in which all the topics embraced in the work are related to each other, and their mutual dependences, by constant references from one part to others; and, what is unusual, the Author has made these connecting references in a prospective as well as retrospective manner. With a view, also, to the same objects, the Author had designed a more copious Index; but as the stereotype was completed as long ago as the middle of November, and as the state of his health, and other avocations, have not permitted him to complete the Index, in its regular order, beyond the 125th page, he has concluded to print it as it now stands, and to extend it in a future edition. Many subjects, however, throughout the work, are now incidentally carried out in the Index; but many of the most important receive only a general reference, excepting as they are related to others which are more amply noticed.

New York, *Jan.* 1, 1847.

PREFACE TO THE FOURTH EDITION.

Three Editions of these Institutes, the first of which was published in 1847, having been exhausted, the Author now submits a fourth to his medical brethren, in which he has endeavoured to incorporate, in an Appendix, the most important of the recent discoveries in Physiology, Pathological Anatomy, Therapeutics, Organic Chemistry, and Microscopy that are relative to the principles about which this work is interested, and he has connected the Appendix intimately with the main body of the work by copious references to the sections embraced in the former, while the same system is carried out reciprocally in the latter. It is also gratifying to the Author to pay his humble tribute of admiration particularly to the immense labors of the microscopist, who, through the great improvements of the instrument, is now enabled to analyze with surprising accuracy the ultimate and varying conditions of the solids and fluids. The Author has also fulfilled his design, as expressed in the Preface to the first edition, of extending the original Index, a second one being now added, in which he has endeavoured to present an epitome of the whole work. It is proper, however, to suggest that the Reader will find an advantage in consulting simultaneously the original Index, as it is more particularly analytical. An Essay upon the Soul and Instinct forms a part of the Appendix.

New York, *November*, 1857.

PREFACE TO THE FIFTH EDITION.

The Supplement which is added to the present edition embraces observations that go to corroborate some of the Author's principal views in medical philosophy; but he is not aware of any discoveries in Physiology, or of any new facts in Pathology, or of any improvements in Therapeutics since the late edition to affect adversely any of his doctrines. Indeed, as a work of principles, and as a consistent whole, should any doctrine of importance be shown to be fallacious, the entire fabric must be abandoned. But if, on the contrary, its principles be founded in Nature, they can not be affected by any future accumulation of facts—no more than the law of gravitation was rendered more absolute by the successful calculation of the periodic time of Halley's comet. That achievement was simply a corroboration of a great discovery. It is of no importance, therefore, to the essential objects of this work to introduce new discoveries till some one or more may present themselves, that, like chlorine, iodine, &c., in their relation to Lavoisier's theories of oxygen, shall invalidate the system of medical philosophy herein embraced; by which the Author means such facts as can be undeniably shown to contradict that philosophy. This, it is true, will appear strange to those (and of such there are many) who look upon principles as "liable to exceptions" —as having no stability—exposed to daily fluctuations—as consisting even of isolated facts; such philosophers, particularly, as see no discrepancy between the conflicting laws of organic and inorganic beings, and who, therefore, are ever ready to engraft them indiscriminately upon organic philosophy, or as one or the other may have its chance in the irresistible pronunciations of organic life, or in the spurious analogies of simple matter. To multiply facts in this work which merely contribute to the validity of its principles, or to incorporate others that may be speciously arrayed against those principles, would constitute a defect for the most ordinary criticism. Nevertheless, some things, both of the former and latter nature, have been admitted into the Appendix, although precisely parallel facts occur in the body of the work. But they were said to be new, and the Author yielded to this general belief, though he concedes that the facts are more fully displayed in the latter than in the former cases, and that he therefore contemplated an advantage from their corroborating effect. But their exclusion would not have otherwise affected the work, though it might have been regarded by some as a defect. The same may be also affirmed of the Supplement, where, for example, some late observations relative to absorption by the intestinal villi are stated, although they simply confirm what had been long ago ascertained; but they are more precise and complete, and place the doctrine in these Institutes beyond question.

New York, *August*, 1859.

PREFACE TO THE SIXTH EDITION.

A CAREFUL attention has been bestowed upon this sixth edition, as will be sufficiently manifest in the numerous references which have been added to the sections wherever the subjects under consideration are allied to other parts of the work and may derive illustration through this relationship. These new references (which occupy mostly the former vacant spaces at the end of sentences) are prospective as well as retrospective, and amount to more than seventeen hundred; and the Indexes have been improved in a similar manner. The Author has also endeavored to simplify the exposition of some of the most difficult problems, and to thus render them of more easy comprehension by the young medical student. For this purpose he could have equally desired greater amplification, and especially to protect himself against misapprehension or misrepresentation (from the latter of which, however, he is not so unwise as to hope for escape); but the vastness of the field, the immensity of the labyrinth which he has explored, has rendered it necessary to employ as much brevity as such variety and intricacies would admit, and he has considered it most expedient to carry into the APPENDIX and SUPPLEMENT the same compactness that characterizes the body of the work. Of the SUPPLEMENT it is said that "it is very brief, but speaks a volume."

But whatever advantages in respect to detail and perspicuity may attend a work upon the principles of medicine as founded in Nature, it can have but little chance with other systems unless the student be ambitious of knowledge, and disposed to grapple at the very beginning of his career with the difficulties of truth as distinguished from the fascinating simplicity of error. The latter once impressed upon his imagination, or once productive of mental indolence, fetters his aspirations and decides his destiny. Hence the incalculable importance of a right beginning. Whatever the apparent obstacles, they may be soon surmounted. The task will have been the best possible mental discipline for the young inquirer. He will have learned the important art of thinking for himself; and when once inducted into the true philosophy of medicine he can not help thinking, and into the very depths of that philosophy. He will have also shielded himself against the seductions of artificial systems. He will quickly distinguish what is true in Nature from factitious analogies. He is not, however, to be discouraged from informing himself of spurious doctrines; and with this object in view the Author of these Institutes has incorporated in the work a copious exposition of the offsprings of

error. But, as he has also endeavored to indicate their fallacies, the student has the double advantage of learning the inventions of art and at the same time the infirmities which are so apt to commend them to our natural indolence. The Author's method, therefore, if he be right in his premises, is not open to the objection alleged by Burke (but on the contrary defeats it), that—"When education takes in error as a part of its system there is no doubt that it will operate with abundant energy and to an extent indefinite."

Much has been recently said by a few writers upon the *recuperative law of Nature*, and presented in such a manner as to convey an impression that now, for the first time, the old doctrine of the *vis medicatrix naturæ* has been distinctly announced. The Orator, for example, of the London Hunterian Society for the present year remarks that—"From time immemorial the professors of the healing art, with one or two exceptions, seem to have known nothing of the course and termination of diseases, save in connection with, and as modified by, special therapeutical agents. Nearly all their reasoning upon the action of medicines has, in consequence, been based upon comparisons of one method of treatment with another. They seem never to have thought of taking as the basis of their reasoning the curative resources of Nature herself, as ascertained by study of the natural course of disease."

It is evident that they who have lately written in the foregoing manner have had their attention diverted from Hippocrates, Celsus, Galen, &c., and if they will turn to the *mottoes* at page 661 of this work they will find that those early masters "took as the basis of their reasoning" what is supposed to be of such very recent origin. And the Author of these Institutes, unwilling to be excluded, may be permitted to assure these reformers that throughout the work he has "taken as the *basis* of his reasoning the curative resources of Nature herself, as ascertained by study of the natural course of disease." It is the *absolute foundation* of all his Therapeutics, and the foregoing mottoes were employed to indicate the fact. But these reformers have, also, nearly as large a reliance upon Nature as the homœopath, with much less regard for the noble science, and appear to be of Magendie's opinion that "the nurse can prescribe equally well" (§ 744); and perhaps this may be what is intended by claiming for the honor of the present age the discovery of the *vis medicatrix naturæ*. In that aspect of the subject the Author of these Institutes does not sympathize (excepting as it respects a few "self-limited" diseases, and multitudinous cases in which there is no profound derangement, results of mechanical injuries, &c.), although he endeavors to expose the errors of excessive medication, and agrees with the *abortive* disciples of Nature that wherever this practice obtains (as it does with the mass of the profession) the whole work of cure is supposed to devolve upon art; and this, he maintains, is the inevitable effect of the chemical and humoral doctrines.

Nature, in the foregoing sense, is nothing but a system of laws, a proper conformity with which is as much at the foundation of therapeutics as of hygiene. The physician, therefore, should be alone employed in applying to his use the laws by which organic beings are governed. A vital principle, or vital force (as may be preferred), in connection with organic structure, forms the basis of those laws.

Such is a glance at some of the objects of this work, and to which the Author invites especially the impartial attention of the young student of medicine, and with the assurance that he will meet with no timid or unfair concealment of doctrines that are opposed to those of the Institutes.

There remains to be noticed what may seem to be an isolated subject, but which is essentially relative to physiology—the essay upon the Soul and Instinctive Principle (incorporated in the APPENDIX), in which the Author endeavors to demonstrate the substantive existence and self-acting nature of the Soul and Instinct upon strictly physiological principles. If this have been accomplished by the Author, who believes the demonstration to be conclusive, then is there an end to *materialism;* and even he who doubts not the probabilities of the metaphysical inductions, or relies with greater confidence upon Revelation, must realize a new satisfaction in that tangible proof which no ingenuity can invalidate, no misrepresentation pervert, and no sophistry evade.

As to the Author's reference to his essay upon "Theoretical Geology" (p. 908, 927), it will be seen that the work embraces many facts that are allied to organic philosophy; but it is now his object to state that the discussion proceeds upon recognized grounds in natural philosophy, chemistry, geology, &c., and without departing from the rules *prescribed* by "positive science;" and as the Author's aim is simply the development of truth, he entertains the hope that the essay may be scrutinized according to its supposed philosophical premises. The issue must ultimately turn upon this mode of investigation, not upon the usual ground of geological hypotheses, which, indeed, are the very things in question. It must be decided in the open field of those various sciences which constitute the physiology of Nature; since the near affinities among the facts in geology constantly bring them under the collective interpretation of the different departments of knowledge, and no one who has not directed his attention to the whole circle of the sciences is qualified to grapple with the subject.

NEW YORK, *September*, 1860.

PREFACE TO THE EIGHTH EDITION.

A SEVENTH edition of this work was published in 1861, which, as stated in a Preface, "is distinguished from the preceding editions by the addition of several brief foot-notes and some other improvements." In 1862 appeared another edition, but under the designation of the seventh edition, though distinguished from that by the addition of twenty pages of NOTES appended at the end of the *Second Index*, and by frequent references to them in the text, and also by the addition of several brief foot-notes, and by many references to sections throughout the work. Doubtless it had been better to have entitled that edition the eighth.

The present edition is distinguished from the last particularly by an extension of the NOTES at the end of the Second Index, and by numerous references to them in the text. Several of the former Prefaces are reproduced as memoranda of the progressive condition of the work. In the Preface to the seventh edition, which is now omitted, there occurs the following explanatory statement: "The author embraces this opportunity to say (what may not be obvious to all) that the fractions which appear in many of the numerical designations of the sections, as § 303¼ *a*, are intended for sections that were made after the original completion of the manuscript, by which the labor of a revision of the entire work was saved. The addition of letters to a series of figures of the same denomination indicates distinct sections, but that they are either closely allied, or are intended as substitutes for fractional parts."

NEW YORK, 1865.

PREFACE TO THE NINTH EDITION.

AN EIGHTH EDITION REVISED of this work was published in 1867 and 1868, in which improvements were introduced. The present or Ninth Edition has also been carefully revised, and, although the text has been in no essential respect altered, some notes have been added.

The Author, in concluding this brief Preface, thinks it but just to himself to say that during the fifty-four years of his professional life he has at no time intermitted his professional labors, either scientific or practical, and that, therefore, he does not offer this new edition of his work in ignorance of the latest contributions to medicine, or when it might be supposed that his interest in the great subject was not as ardent as ever.

NEW YORK, 1870.

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INSTITUTES OF MEDICINE.

PRELIMINARY REMARKS.

"Until it is proved that the forces which, in a living body, interrupt the play of the natural chemical affinities, maintain a proper temperature, and preside over the various actions of organic and animal life, are analogous to those admitted by natural philosophy, we shall act consistently with the principles of that science, by giving distinct names to THESE TWO KINDS OF FORCES, and employing ourselves IN CALCULATING THE DIFFERENT LAWS THEY OBEY."—ANDRAL'S *Pathological Anatomy*. See, also, *Medical and Physiological Commentaries*, vol. i., p. 626–632.

"Our notion of life involves something more than mere reproduction, namely, the idea of an ACTIVE POWER, exercised by virtue of a definite form, and production and generation in a definite form. The production of organs, the co-operation of a system of organs, and their power not only to produce their component parts from the food presented to them, but to generate themselves in their original form and with their properties, *are characters belonging exclusively to organic life*, and constitute a form of reproduction INDEPENDENT OF CHEMICAL POWERS. This VITAL PRINCIPLE is only known to us through the peculiar form of its instruments; that is, through the organs *in which it resides*. Its LAWS must be investigated just as we investigate THOSE OF THE OTHER POWERS WHICH EFFECT MOTION AND CHANGES IN MATTER."—LIEBIG'S *Organic Chemistry applied to Physiology*, p. 355.

"Simple views, whether of health or disease, however ingenious, can seldom be just. They have their origin in the spirit of system, not in the careful study and faithful enumeration of the complicated circumstances which concur in the production of all vital phenomena."—THOMPSON, *on Inflammation*.

1, *a*. SOLIDISM and vitalism will form the basis of these Institutes. If consistent in all their parts, without a violation of facts, it is, *prima facie*, a proof of their foundation in Nature. To show this consistency, and to develop the great principles and laws of organic beings, and erect a substantial fabric of Institutes which shall guide the hand of art, we must ascend, progressively, along the fundamental facts in physiology, pathology, and therapeutics; till, at last, we proceed to convert the great system to practical uses, in the preservation of health, and a just, intelligible, and philosophical application of the materia medica to morbid states of the body.

To render this work, therefore, most practical, and to simplify as far as possible the highest department of knowledge, I shall adopt an analytical method. I have also endeavored to arrange the various topics in their most natural order, or as each successive one may appear to emanate from, or to depend upon, the preceding. The student, therefore, to understand the last, must comprehend all the preceding, and so of each in succession. We have thus a connected link throughout; a difficult achievement, and the more difficult as it is the first effort that has been made to present the natural relations of my whole subject in their just order, to point out the affinities, and to exhibit throughout the important laws and essential foundations of vitalism and solidism, and to maintain throughout a consistency of facts and of laws that shall stamp the whole as the *Philosophy of Medicine*.

In making this claim for the Institutes, I am prepared, as in the case of the *Commentaries*, to invite the most rigid scrutiny.* If there be any where a collision in principles or facts, or any contradictions of myself, let them be pointed out. My aim is truth, and I desire

* MEDICAL AND PHYSIOLOGICAL COMMENTARIES, New York, 1840.

nothing for myself which I do not yield to others. If there be minor imperfections I would gladly know them. Many of the original doctrines which appear in this work are presented in various connections in the *Medical and Physiological Commentaries.* The spirit of the Commentaries will pervade the Institutes, as being, in my judgment, the only stable foundation.*

1, *b.* In the farther prosecution of this work it will still be my object to speak of such errors as have usurped the rights or blighted the interests of rational medicine. It is not now the time for a simple expression of facts, of experience, and of philosophical doctrines. The errors which surround them must be also exposed and refuted, or the foe of truth, or the ambitious aspirant, or the lover of indolence, will gain something from an indulgence which they know how to seek and appropriate. Nor is any one more aware of the tendencies of free discussion or unsparing of physiologists than he who has been most successful in the propagation of error, or who would sooner stifle inquiry into factitious systems. Thus, it is said by Liebig, that

"It is too frequently forgotten by *physiologists* that their duty really is, not to *refute* the experiments of others, *nor to show that they are erroneous,* but to discover truth, and that alone."—Liebig's *Organic Chemistry applied to Physiology, &c.*

Now this obvious sophistry betrays its motive, since it is utterly at variance with the habits of him who would enjoin the fiction upon others. Truth should be, indeed, the ultimate object of pursuit; but the first and most important step toward its attainment is the removal of obstacles that may lie in its way (§ 820). It is allowed, indeed, by one of Liebig's most zealous advocates, the editor of the *London Lancet*, that "*the removal of error claims a place next to the establishment of truth*" (Dec., 1844); and it has grown into a proverb, that "it is more difficult to subdue a prejudice than to build a pyramid."

Although, therefore, the contemplated method must be sometimes argumentative and controversial, it has the advantage of leading more immediately to a knowledge of the truth upon disputed questions, than any other which is not demonstrative. There can be no doubt, indeed, that the "establishment of truth" in medical philosophy can be effected only by a simultaneous refutation of the errors which surround it. The mind will not surrender a favorite doctrine, however false, to the force of truth alone. Even its practical disasters, as we every where witness, are an inadequate demonstration. But, when error and truth are presented in forcible contrast, it is the pride of reason to embrace the latter. What is also important, the reader will have been presented, as in the *Commentaries*, with the great rival doctrines in medicine, and in their proper relations to each other (§ 350½).

2, *a.* The Institutes of Medicine are natural inductions of principles and laws from the healthy and morbid phenomena of living beings. They relate to Physiology, Pathology, and Therapeutics, and to nothing else. All other systems, therefore, must be spurious. The substitutes have no depth, no principle, no laws, and are recommended alone by their naked simplicity. "Gentlemen," says Bacon, "nature is a labyrinth, in which the very haste with which you move will make you lose your way."

2, *b.* The immediate objects of physiology are a critical analysis of

* The author has seen no reason to modify this statement, made more than twenty years ago—1870.

the vital conditions and results of organic beings, as manifested in different organs, and in their relations to each other. It contemplates organic nature, therefore, in its natural state; and the laws which it obeys are its highest end. Pathology is to the physician the great final object of physiology. It investigates the causes which disturb the physiological conditions, and inquires into the phenomena, and the nature of the vital and structural changes. These, in connection, form the ground-work of Therapeutics, which considers the indications to be fulfilled, and the means and the manner by which they are to be accomplished, and nature thus aided in the process of cure. The Materia Medica comes last, and is the subordinate object of all the rest. It investigates the composition and physical character of the material objects by which the therapeutical intentions are fulfilled, and interrogates especially their relations, as vital and alterative agents, to pathological conditions. Disease, being a modification of the physiological or natural condition, produces new relations between the properties of life and the natural, morbific, and remedial agents; and these are ascertained by observation of their effects upon morbid states alone. It is thus that remedies become beneficial when they would be morbific in health; and what is salubrious in health is rendered morbific by diseased conditions. The principle is in beautiful harmony with the instability of the vital properties; and the final cause of this instability is the preservation of organic being (§ 133, *c*, 153–156, 638).

2, *c*. Nevertheless, each of the four great departments of medicine possesses so many peculiar characters that they may be severally considered as constituting, to a large extent, distinct parts of one great symmetrical whole (§ 83, *c*). Pathological conditions could never have been inferred, *à priori*, from any extent of physiological inquiries, nor could the effects of therapeutical agents, or the natural termination of disease in health or in death, from any knowledge of anatomy, physiology, or pathology. The whole is originally the work of observation; and we come to learn the relations of the four great branches of medicine by comparing the phenomena which are presented under the various conditions of health and disease, and as these phenomena may be affected by artificial influences.

Anatomy, however, affords no such standard of comparison. And yet it is obvious, as will more distinctly appear hereafter (§ 83–163), that anatomy is the basis of medicine. It is, however, of the system of organic life that I mainly speak. All, at least, that is superficial in animal life, the voluntary muscles, &c., abstracted from their relations to the organic condition, belongs to the domain of surgery, and is, therefore, of little importance to the physician.

2, *d*. Notwithstanding, therefore, the foregoing qualifications, it will be seen, in our inquiries into the great fundamental points, that the science of medicine is, throughout, a perfectly connected chain; beginning with the laws which govern the modes in which the elements of matter are combined in organic beings,—advancing to the union of organic compounds into cells and tissues,—to the laws which respect the various processes which are conducted by these tissues, and by the organs into which they are combined,—to those laws as affected by the contingencies of disease,—and, lastly, to the laws which regulate the changes through which the morbid states return to

the natural conditions of life. All are connected together by intimate dependencies, and are determined by the natural or by the varying states of the vital properties in their operation through material parts. The ground-work of the whole is, evidently, perfectly simple; since the laws by which the whole is regulated are established upon the constitution of the organic properties (§ 169, *f*, 638).

2, *e*. To the eye of the philosopher, therefore, Nature, in her organic department, as in every other, appears in an aspect of astonishing simplicity, when he contrasts her forces and laws with the diversity of their phenomena; nor does he confound the principles and laws which distinguish the different departments of nature. To every other eye the phenomena of life appear confused, and seem referable to no common powers or laws. But he who has obtained the key to the true philosophy of life, by a wide observation of nature, lays open at once the apparent secrets of all its results, whether in health or disease. Whatever he sees has its individuality, and stands in relief from all the rest. He knows at a glance from whence this or that springs, how it is related to others, and he traces the whole directly up to a few simple principles. To all but such an eye, however, the phenomena of life, and more especially of life diseased, appear as does a field to all but the botanist. The common observer sees nothing but a confused assemblage of grasses, and probably will tell you there is but one species where the botanist will as instantly discover fifty. Each species has to the latter a distinct individuality, and he cannot regard them in that state of confusion which is seen by the ignorant. He has studied each plant, knows its specific characters, its relations to others, its habits, &c. By these modes of observation he has also acquired the knowledge that nature has pursued a common plan of organization, and linked the whole, by close analogies, throughout the vegetable kingdom. Were the botanist, therefore, to range simultaneously among the 100,000 species of plants, he would see nothing but individuality, and the greatest simplicity in the principles upon which the whole are constituted. And just so it is with a philosophical observation of the healthy and morbid phenomena of the animal kingdom.

3. The organic and inorganic kingdoms have, respectively, their peculiar properties and laws. Such as appertain to life, in its natural, as well as morbid aspects, are denoted by an incomparably greater variety of phenomena than those of the external world; and as their only intelligible foundation is the phenomena evinced, we attain our knowledge of either according to the extent and variety of the phenomena. We know nothing more of matter itself.

Without a comprehensive knowledge of the properties and functions of living beings, and especially of the laws by which they are governed in their healthy and morbid states, the practice of medicine is mere empyricism. The ignorant, alone, undervalue causes and principles, and depend upon unconnected facts.

4, *a*. In medicine, therefore, we must concern ourselves with something besides effects. We must understand the laws under which they take place, and, as far as possible, trace up the effects to the primary causes. This is always done in other sciences and in the arts. Why, then, should it be neglected in that science whose practical application relates to the highest welfare of man?

The human mind will have its theories upon all subjects; and the whole history of medicine is a perpetual exemplification that in no inquiries do theory and hypothesis abound so universally as in the healing art (§ 819, 960). This arises, in part, from the intricacies of the subject, but mostly so from the constitution of the mind itself. The Almighty designed it for theoretical conclusions, and set us the example in those stupendous theories upon which the universe, and all it contains, are founded. And what else are, or should be, our inquiries and our theories, than finding out and adopting those of which He is the author? What other theory in the natural world can there be than such as are instituted by the Almighty Being? And shall we hesitate to embrace, and to act upon such theories? And yet it is one of the pretended improvements of the day to insist upon nothing but facts, and to denounce all principles in medicine; as if the Almighty had not ordained principles and laws as well as facts, which are mere emanations from the former.

4, *b*. The ignorant pretender will tell us that all this is unimportant; though no one is so much directed by hypothesis, or theory, as this very pretender himself (§ 884). Does not every empiric in the land prescribe his drastic cathartics for the purpose of cleansing the blood of its supposed impurities? Are they not exactly on a par, in their doctrines, and in their practice, with the most speculative of our enlightened humoralists? Nay, have the ignorant portion of that sect, our Brandreths, our Morrisons, *et id omne genus*, any reference whatever to facts or experience? Is it not all hypothesis, and, therefore, all a reckless waste of human life? Mount up the scale, and you shall find at every step of your ascent, from him who prowls about the outskirts of the profession, to him who directs the all-potent drug with the most consummate skill, that each and all rely mainly upon their conceptions of the philosophy of disease. But you shall also find, that in proportion as Nature has been taken for their guide, and as medical principles are founded upon the absolute phenomena of life, in their healthy and morbid aspects, *there* will always be the greatest reference to facts and experience.

Hence, again, the importance of looking well to our theories, and of seeing that they are established on well-grounded facts, or on the analogy to which they conduct us. Could we, as we cannot, direct the treatment of disease without principles, we never should; and it should therefore be the business of the practitioner to enlighten his mind upon the philosophy of medicine, or his unavoidable disposition to theorize may prove a scourge to mankind. Of this, indeed, the records of medicine abound with examples (§ 801, *b*, 819, &c., 960, 1005, 1068).—Notes F p. 1114, Ee p. 1133, Ff p. 1135, Gg p. 1138.

It will therefore be my agreeable task to expose, in these Institutes, the fallacies of the prevailing physical doctrines of life and disease, as well as to inculcate principles which exalt our science above the mere world of matter, render it consistent in all its details, and present it to the profession as a department of knowledge fundamentally distinct from all other pursuits.—See Rights &c. p. 912.

Differences of opinion on questions of great moment to mankind are apt to be strongly conveyed, and apparent error to be censured in no measured terms. This, perhaps, is often admissible, considering the obstinacy of error, and so long as it is the doctrine. and not its au-

thor, which is assailed. We may revere the names of Voltaire, of Hume, and of Gibbon, yield them a proud rank in the scale of intellect, and gratefully acknowledge the rich legacies they have left behind. But, who of us would hesitate to speak of their infidelity according to its nature and tendencies? This is even demanded by what we believe of the precepts of religion. And so of the principles of medicine, which hold as high a relation to the temporal interests of man as do the precepts of religion to his spiritual welfare. The highest order of intellect is often devoted to the dissemination of error, and perhaps more frequently in religion and medicine than in any other of the great interests of mankind. This must be fully and firmly met, not only by evidences of the truth, but by an exposure of its perversions and corruptions.

4½, *a*. The physiological world has been lately divided into three schools. One of these sects virtually regards organic nature as a part only of inorganic, endowed with the same properties and governed by the same laws. It maintains, in short, that there is no essential difference between a man and a stone. At the head of this school stands Liebig, the distinguished and able chemist. It is a great and powerful school, but is falling, daily, beneath the weight of its vast errors and corruptions. It is denominated the *chemical school* of medicine.

4½, *b*. Contrasted with this is the school of *vitalism*, which regards organic and inorganic nature as distinct in their most essential attributes. It supposes that each department is governed by properties and laws peculiar to itself. It regards the organic being as fundamentally distinct from the inorganic in its elementary constitution, in the aggregation of its molecules, in the structure of its parts, in its condition as a whole, and in every phenomenon which it evinces. It sees design in every part of the living being—eloquent even in the dry bones of a skeleton; a design peculiar to every part, while all concur together to the common ends of the more universal designs of procuring the means of sustenance, of maintaining life, of perpetuating the species, &c. On the other hand, this school discerns no corresponding design in the constitution, or in the condition of inorganic matter. It sees nothing here but mere *vis inertiæ*, which, however, is supposed by the chemical school to be capable of evolving from simple matter every variety of organization, with all its specific designs, even instinct and reason, while, at the same time, we hear from the depth of materialism that "organic nature is the mystery of mysteries"—the CREATOR being the only "mystery" about it.

Again, the vitalists, in consideration of the facts now stated, maintain, in the language of Liebig, the great head of the school of mere physics, "the existence of a principle distinct from all other powers of nature, namely, a *vital principle;*" which organizes and governs all living beings, and which is the fundamental cause of all their phenomena in health and disease. I say, in the language of Liebig, "a principle distinct from all other powers of nature;" for this mere chemist, in his conflicts with living nature, concedes the existence of such a principle as at the foundation of all vital phenomena, yet, in the same general manner, and on all specific questions where he had introduced its direct and exclusive agency, he as unequivocally declares that there is no such principle, and that every result of life and disease, even thought itself, are entirely owing to chemical agencies

His whole system, as set forth in his "Organic Chemistry applied to Physiology," and in his "Animal Chemistry" as applied to Pathology and Therapeutics, is a tissue of similar contradictions, and of the boldest assumptions. Yet, with deep mortification I say it, he has been hailed with an enthusiasm before unknown in the annals of medicine, as the only true expounder of physiology and of medical philosophy. The world, however, is fast awaking from its spell-bound delusion, and the doctrines of this "reformer" will soon be mingled with the same and more original chimeras which did their part in "the dark ages of science" (§ 350, 1029, 1030, 1034).

4½, *c.* Finally, the third school, or that of *chemico-vitalism*, endeavors to form, as it were, a bond of union between the schools of pure vitalism, and of pure chemistry; though such an alliance be as unnatural as human brains in a block of granite. The chemico-physiologist makes a compromise with philosophy, and takes for his rule "*in medio tutissimus ibis.*" It is as regardless as the school of pure chemistry of the universal consent with which physiology has been hitherto restricted to the condition, functions, results, and laws of *living beings*, and chemistry to the condition and laws of *dead matter*. This school, therefore, mingles the doctrines of vitalism and chemistry; allotting to the former one half of the phenomena of life, and the other half to the latter. This is the school to which the young student has the greatest chance of becoming the victim; for it is apparently recommended by the conciliatory principle which I have stated in the form of its motto, and by many of the most distinguished members of our profession.

4½, *d.* I have said that it is a remarkable characteristic of the medical school of pure chemistry, that its doctrines are in perfect conflict with each other, as shown in a work (Liebig's "Animal Chemistry") which is assumed as the basis of the chemical philosophy of life—as the great foundation on which the school itself has been erected. And how could it be otherwise, seeing that this school, and this writer, are constantly employed about two subjects which have no affinities; that is to say, the philosophy of life and the philosophy of chemistry? I shall think it of sufficient importance to substantiate the foregoing fact by many proofs in the course of this work; and, as an example of the whole, I shall adduce the contradictory views which are put forth upon the most important principles which lie at the foundation of organic life, and at the basis of medical science. On the very subject of a *vital principle* itself the genius of the school is as flatly contradictory as on the most unimportant doctrine; for at one moment he avows the existence of such a principle "distinct from all other powers of nature," and calls it "the vital principle," which, he says, governs all the processes of living beings (§ 59, 60), and at the next moment he asserts that, "in the animal body we recognize, as the ultimate CAUSE OF ALL FORCE, only ONE CAUSE, the *chemical action* which the elements of the food and the oxygen of the air mutually exercise on each other. *The only known ultimate cause of vital force*, either in animals or in plants, is a *chemical process*."

He renders, as will be seen by ensuing quotations (§ 350), what he assumes as an original fundamental cause of life the indispensable source of another cause, which he avows to be equally original and fundamental; and what is yet more indicative of the chaotic state of

the chemical speculations relative to living beings, this author (as I have shown in the Medical and Physiological Commentaries of many others) assumes, at one time, the chemical force to be the sole cause of all vital processes and results, while, at another time, he regards the vital principle as the only power concerned in the same phenomena. It will be gratifying to curiosity, for example, to observe how Liebig entangles his reader, as it respects the physiology of digestion, by making that process to depend on a purely chemical action, and to evolve that vital principle which he as unequivocally declares to be the only power concerned in chymification (§ 350, nos. 3, 17, 51, 58).

5. Chemical and mechanical philosophy, as we have already seen, are strangers to the philosophy of medicine. There is a natural conflict between the subjects of each. They have no relationship, no sympathies, but carry on a perpetual hostility. The organic being is forever converting to its own uses the inorganic, and changing its very nature into its own. The inorganic is fruitless in resistance and in assault, till the former is passive. It then lays waste the fabric by which it had been wrought into a great system of designs, and degrades the whole to its own level. Chemistry, therefore, begins where physiology ends; and physiology begins with organic influences upon the elements of matter, or where chemistry leaves off. No department of medicine has any thing to hope from chemistry beyond its power of analysis (§ 1029, 1030).

And yet do the labors of chemists aspire at a substitution of the ever-fluctuating principles of chemical science for all that has been hitherto founded upon the phenomena of life and disease. Their oft repeated effort to carry a science which is mainly analytical and mechanical into that which is eminently intellectual and overflowing with the most sublime institutions, and distinguished by the most profound principles and laws of nature, and therefore seductive to an ambition which is restif under the practical manipulations of the laboratory, would raise no inquiry as to motive, or end, did not the proper guardians of the science not only abandon their old and rich domain at the very approach of the enemy, but, with most unnatural distrust of self, invite the destroyer (§ 349, *d*, 433, p. 719, § 960, *a*).

The late publication of Liebig's "Animal Chemistry" has abundantly proved the truth of what I sufficiently established in the "Medical and Physiological Commentaries," that the recent application of chemistry to physiology and medicine is not a partial, but a complete substitution of that science. In justification of all this, we are now told that the means of investigation, of analysis, and of creation, have received an extension of which our predecessors had no knowledge. Such, however, has always been the pretext of chemistry for its invasions upon the science of life. Take, for example, the words of Fourcroy, who wrote more than sixty years ago,* and who, like Liebig and his school, attempted to substitute chemistry for physiology, and to rear up a fabric of medicine upon that imaginary foundation; and this, too, in the case of either of the masters, without having ever read a medical book, or having ever prescribed for a disease. The language of Fourcroy is exactly such as we now hear from the lips of Liebig and his followers; who cheerfully allow that nothing flowed from the labors of Fourcroy to illuminate the dark ways of organic life (§ 1029, 1030).

* Now more than eighty years—1870.

So identical are the language, and ambition, and hope or confidence, and the visionary speculations, of the older and recent chemists, that a space may be well assigned to this exposure of chemical pretensions. We read, then, in Fourcroy, what we read in the works of Liebig and his cotemporary chemists. Thus :

" The errors of the chemical physicians of the last century, and the indifference many practitioners of the present time seem to have for chemistry, have produced a disadvantageous opinion in the minds of many persons, *which time alone can remove.* If the *enthusiasm* of those physicians, who cultivated chemistry, *misled them*, it does not follow that any conclusion can be drawn from thence *that may be applied to the present time.* THE EXACTNESS WHICH THE MODERNS have introduced into every part of *experimental philosophy* ought to remove the apprehensions of such as, for want of acquaintance with the subject, are apt to imagine that chemistry is still the dark, mysterious science it was a century ago." " It is chemistry alone that can throw any light on the composition of the fluids, and the *changes they undergo by the processes that are carried on during life.* We cannot avoid having recourse to this science, in our endeavors to discover the true mechanism of the *animal functions ;* the *properties of the fluids* separated by the different viscera ; or the *alterations* such fluids undergo." " It will be necessary to enlarge and multiply these researches on subjects of different age, size, and temperament, in various climates and seasons, and to pursue them among the different classes of animals," &c. " We think it equally necessary to examine the *solids,* by chemical methods, as well in the sound as in the diseased state, and *by a comparison* of their properties, endeavor to discover *to which of the fluids* they owe their formation ; and this being known, we may proceed to conjecture, in morbific dispositions, the solid or fluid that has suffered a change.

" If it be *thus established* that the theory of medicine is capable of receiving the most essential advantages from chemistry, it is equally certain that *the practice* is no less in need of the same assistance ; since both must of necessity accompany each other, and are promoted by the same means." " Nothing can be more evident than that the *choice of aliments,* and of air, cannot be made with any certainty, but in consequence of *chemical researches into the nature of foods,* and the properties of the atmospheric fluid" (§ 18).—FOURCROY'S *Medical Chemistry,* 1782.—Also, APPENDIX § 1028–1030, 1034, LEHMANN.

I have said, in the Commentaries, that " a prosperous harvest" was promised from Fourcroy's reformation. But, again I reiterate, where is the evidence ? since which time, also, chemistry has made greater advances than any other science, has had its unmolested sway, and Fourcroy's example has been followed with a corresponding diligence. Can you point to a solitary instance in which organic chemistry, except in a negative sense, has advanced the science of life or disease ? Do not the very chemists of this day incidentally allow the perfectly abortive nature of their science in relation to physiology and medicine ? Consult the quotations in section 350, *b*, 1, &c., and 350¼–350⅔. Or take the affirmations of the distinguished Mülder (§ 350¾), which go, with the rest, to establish the truth of my former assertion, that "*chemistry has been a perfect incubus upon medicine ; and the time is not distant when it will have proved, by its own showing, its want of*

relation to our subject, if it have not done so already."—Comment., vol. i., p. 586, *note.*—See APPENDIX § 1028–1030.

5¼, *a.* I agree with the chemical physiologist that "facts are stubborn things," and, with the analogy which reposes upon them, are at the foundation of all philosophy; but it does not equally follow that facts are always philosophically or even honestly applied, nor that he who devotes himself to the laboratory is the best qualified to apply his own facts to organic nature. "We can have no very high idea of experiments made by gentlemen," says Hunter, "who, for want of anatomical knowledge, have not been able to pursue their reasoning even beyond the simple experiment itself." Least of all can the chemist be permitted to charge upon the vitalist a neglect of chemical facts; since it is as well by these as by the phenomena of life that the vitalist overthrows the artificial system (§ 350–350⅔). Nor let it be forgotten that it is purely by an appeal to certain false analogies, and by a disregard of the phenomena of living beings, that the physical and chemical hypotheses of life and disease have obtained their ascendency (§ 733, *d*).

All our theories and principles in medicine, it cannot be too often reiterated, should rest upon well-ascertained facts. The great difficulties with which truth has had to contend since the restoration of the proper method of observing nature consists in the mistaken nature of facts, or of false conclusions from admitted facts. What is often assumed to be fact is just otherwise, and, where the premises are sound, they have frequently led to spurious theories (§ 350½–350¾, 433, &c., 493, 823, &c.).

5¼, *b.* The phenomena of nature are the facts about which all philosophy is concerned, and therefore form the substantial ground of all intellectual acquirements. As they relate to organic beings, to their laws, their properties, their functions, whether morbid or healthy, they are to be found in the organic being himself, not in the workshops of the chemist or of the mechanical philosopher. But, even where the mind admits this proposition, if prone to speculation, it too often regards each fact by itself, and rears up hypotheses wrong in themselves, and in conflict with each other. Facts should therefore be compared before they are reduced to theory; or, where they may conflict with acknowledged principles they should remain in an isolated state till their true nature may be better understood, or till the principles which they appear to contradict may be shown to be erroneous. Should some fact, for example, appear to indicate the dependence of life upon chemical or any other physical forces, the evidence to the contrary is so various and conclusive, that *that* fact must be considered as deficient in some of its elements, which, if known, would readily bring it under a well-established principle in physiology. These absent elements are some other facts which escape our observation; and thus what is truly fact, in an abstract sense, is made the ground-work of important error.

5¼, *c.* It is the peculiar misfortune of science to generalize too hastily; and it often happens that the explosion, or the introduction, of one error, is the parent of many others. It is also astonishingly true that a few phenomena are abstracted from the whole, of which they may be only sequences of the others, and are made the ground of conflicting doctrines, and substitutes for the theories that are insti-

tuted upon the more fundamental facts; and thus a blind disregard of consistency is permitted to prevail till a most incongruous series of assumptions, as in Liebig's Animal Chemistry, is presented to us as the science which Nature teaches.

Again, there is a proneness of the human mind to admit of no realities but such as make a strong demonstration upon the senses; and hence it is that the physical and chemical philosophers of life prefer the facts of the laboratory to such as are supplied by organic beings. The former are therefore assumed as the foundation for principles and laws in physiology and medicine; and when it is considered how large a proportion of mankind have not the ability to distinguish the true from the false, especially when the latter is set forth in a confident and dogmatic manner, it ceases to be remarkable that what is comparatively simple, and comes plausibly recommended by the tangible and visible attributes of matter, should command their confidence beyond those realities which can be appreciated only by an exercise of the understanding in connection with the revelations of sense, and which form the ground-work of principles of difficult penetration. There are few, indeed, who are capable of reasoning beyond their senses and the facts themselves, and this is equally true of the chemist, both as to the facts of the laboratory and the phenomena of living beings, whenever he attempts an exposition of the properties and laws of a department of nature which lies not within his sphere of investigation. "Truth, whether in or out of fashion, is the measure of knowledge and the business of the understanding. Whatever is beside that, however authorized by consent or recommended by variety, is nothing but ignorance or something worse" (§ 1034).

5¼, *d*. It cannot but be conceded, that, as knowledge advances, and the subjects of inquiry become more or less exhausted, ambition is likely to depart from an observation of nature to seek gratification and renown in artificial expedients. This is becoming a prevailing propensity in medicine; and many have left, and are leaving, the bulwark of knowledge to rear up hypotheses upon distortions of nature, which, for their better success, they dignify by the name of "experimental philosophy" (§ 1085).—Note Pp p. 1142.

5¼, *e*. In medicine, at least, there is but one kind of experimental observation, which consists in the simple study of the phenomena of nature. Or, if art be applied to give them a fuller development, the means must be such as shall elicit results conformable to the institutions of nature. But aside from chemistry, it has been the fatality of the physiological department of medicine to have been encumbered with rude experiments, giving the wildest distortions to the features of nature. When we consider the wonderful susceptibility of the properties of life, how readily their actions and results are influenced by natural agents, how a drop of hydrocyanic acid, or of the alcoholic extract of nux vomica, applied to the tongue of an animal, will extinguish life in an instant; or that the same may be done by thrusting a needle into the medulla oblongata; or how concentrated miasma may almost as instantly induce an attack of fever; or how a little excess in eating may bring on an attack of apoplexy as immediately fatal as a blow on the region of the stomach—fatal, perhaps, in either case, as the artillery of the clouds; or how simple irritations of a nerve may be followed by death from tetanus; or how all the veg-

etable and animal poisons, as well as all things else which do not possess natural relations to the properties of life, will variously change those properties and all their results,—when, I say, we consider all these things, we may well imagine the difficulty of imitating nature by the most cautious experiments, or of developing her laws by mutilating the structure of organic beings, or of illustrating those modifications which spring up in disease, by resorting to processes which are foreign to natural influences. Even the greatest experimentalist in modern times, he who has performed more vivisections than any other man, has placed it upon record, that it is one of the most difficult things in physiology to perform an experiment that shall not be liable to objection. Yet no man ever ventured more hastily upon conclusions from such experiments, and none has thrown greater ob stacles, in consequence, in the way of physiology and pathology.

5¼, *f*. The limits which restrain the interposition of art are very narrow; and when organic nature is brought under the influence of artificial causes with a proper reference to these limits, the resulting phenomena may form a safe ground of reasoning as to the laws by which organic beings are governed. Much has been accomplished, in this way, as to the physiological connections of the nervous system with organic actions, the part which it takes in the morbid processes, the sympathetic communications which it establishes throughout the organization, and the interpretation which it supplies of the operation of remedial agents. Nevertheless, the most important part of our knowledge upon these great and intricate questions is abundantly supplied by the natural phenomena of life, as manifested under the varying conditions of health and disease. And that this is so, is sufficiently evident from the fact, that but little *practical* information of the foregoing nature has been added, by recent experiments, to what had been known centuries ago. The late experiments, however, upon the nervous system have confirmed what had been deduced from the more natural process of observation, and have developed some useful facts which it might have been impossible to have known by any other method. Such, for example, is the difference of function between the component parts of the spinal nerves; one part being designed for the transmission of sensation and sympathetic influences, the other for the operation of the will and the development of motion. And yet, if analogy were allowed its proper weight in physiological inquiries, as it must be in reality the great basis of medical science,—if there had been less pertinacity as to the necessity of abstract facts for every conclusion, we might have come, by a process of analogy founded upon ultimate facts, to a knowledge of the constitution of the compound nerves. This could have been inferred from their complex functions as evinced by their phenomena, and by associating them with the simple elements of cerebral nerves, where it is plainly seen that some of the nerves have, individually, a specific function, and whose phenomena are destitute of complexity.

5½, *a*. But the reign of "experimental philosophy" which so lately appeared in the mutilations of animals to discover their natural functions; in the injection of corrosive and putrid substances into the circulatory apparatus of animals to illustrate the pathology of human disease; in the transfusion of remedial agents into the same order of beings, and even into plants, to ascertain the virtues of remedies, their

modus operandi as curative agents, and the right treatment of human maladies, has given place to an "experimental philosophy" in which organic life has no participation. This is the "philosophy" against which the observer of nature is now called upon to contend; fraught with far greater evils than the spurious systems which it has so suddenly surprised and superseded. It is impossible to calculate the mischief which must result to mankind from its unrestrained popularity. Something may be gathered from its former effects when chemistry was young; and something from the progress of error under the fresh spur of Liebig's Animal Chemistry (§ 350–350$\frac{2}{3}$, 821). We all know how common the enthusiastic belief that this "Reformer" had overthrown all former systems in every department of medicine; and we may take the following editorial passage from the London Lancet as expressing a very common opinion of the profession as to the application of chemistry at the bedside of disease:

"As organic chemistry marches on the basis of an improved system of medical practice," says the veteran editor, "it will prove imperative that a rigorous examination of the products of the animal frame, the several humors and excretions of the body, should be employed in the investigation of disease. The period approaches when it will be incumbent on us, not perhaps invariably, but still very often, in prescribing,—say, for typhus, or purpura, or any of the numerous varieties of cutaneous affections, that by a chemical analysis we should first ascertain the constituents and proportions of the proximate elements of the urine, the saliva, the expired breath, the perspired matter, perhaps the blood, the fæces of the patient, *before applying our remedies;* and this process may have to be gone through not once only, but several times in the progress of the malady." "The time is, we repeat it, approaching when the FOUNDATION OF PRACTICE ON THE LAWS OF ORGANIC CHEMISTRY will form the distinction between the enlightened physician and the mere pretender" (§ 851, 863, *e;* 883, *b*).—*London Lancet*, *April* 29, 1843. (Also, § 1029, 1030.)

5$\frac{1}{2}$, *b*. In the foregoing quotation we have essentially what is now extensively denominated "the progress of medical science," and the nature of the doctrines to which these Institutes are opposed. These Institutes will be found mainly, so far as physics are alleged to be concerned, by the side of all the most illustrious physiologists from Hippocrates to us, whose general views are thus summarily expressed by Bichat:

"The organic chemistry of the laboratory," says Bichat, "is the dead anatomy of the fluids, not a physiological chemistry. The physiology of the fluids should be composed of the innumerable variations which they experience according to the different (vital) states of their respective organs." "The instability of the vital powers is the quicksand on which have sunk the calculations of all the physicians of the last hundred years. The habitual variations of the living fluids, dependent on the instability of the powers of life, one would think, should be no less an obstacle to the chemical physicians of the present age."

"Again, had physiology been cultivated by men before physics, I am persuaded that many applications of the former would have been made to the latter. Rivers would have been seen to flow from the tonic action of their banks, crystals to unite from the excitement

which they exercise upon their reciprocal sensibilities, and planets to move because they mutually irritate each other at vast distances. All this would appear unreasonable to us, who think of gravitation only in consideration of these phenomena. And why should we not, in fact, be as ridiculous when we come with this same gravitation, with our chemical affinities and chemical compositions, and with a language established upon their fundamental data, to treat of a science with which they have nothing whatever to do?"—BICHAT'S *General Anatomy and Physiology.*

6. We may now readily perceive the reason why chemistry has undergone changes within a few years, while all that relates essentially to the properties and laws of organic beings may have been long since known. The chemist operates, and makes all his discoveries, through the forces and laws of inorganic matter. These he may carry into his laboratory, turn into his test glasses, or involve in his crucible. He can therefore oblige nature to form the same inorganic compounds as she forms spontaneously. He can then separate the elements again, and again oblige nature to recombine them after their original manner. But, can he do the same thing with organic beings? He cannot form the most simple organic compound—cannot even recombine the elements when they are once separated;—although he has then the necessary elements, and in their exact proportions. The reason is obvious. The chemist has not at his command in this case, as in the other, the necessary powers; or, as the chemist expresses it, "he cannot place them in the same circumstances as Nature does."

It is clear, therefore, that while the laboratory is the proper place for the study of the inorganic kingdom, we must go to the organic being itself to learn the nature of the powers and laws by which it is governed. These, then, are the reasons why the laws of organic beings have been long so much better understood than those of chemistry. Every thing is artificial in the laboratory, so far as experiments are concerned; and, if these be not the right ones, or be imperfectly conducted, they will either fail to represent nature correctly, or will give her a wrong interpretation. Hence the great instability of this science; and yet we are told that every new theory in chemistry is applicable to physiology and medicine.

But, it is quite otherwise with organic beings. Here all the experiments are carried on by Nature herself, and they cannot deceive. The various results and phenomena are seen in the being itself, and can be seen nowhere else. They must, therefore, be the true guide, and the only guide, to the powers and laws by which organic beings are governed. These phenomena, too, are astonishingly multiplied in any given being, and new ones are presented as the being may come under new influences. But, this variety is extended almost to infinity when we consider that every distinct species of plants and animals has its peculiar manifestations of life. It is also true that each one of this endless variety is utterly different from any of the phenomena of the inorganic world. And when we take all the phenomena of organic beings in connection, and find a perfect harmony among the whole, the nature of the proof is so various and immense as to conduct us to a right knowledge of the principles and laws of life in all their aspects.

Now all this variety has been perpetually before the observation of mankind, and always presented to our observation by nature herself. It therefore ceases, I say, to be remarkable that the science of life had so greatly outstripped that of chemistry; and it will probably forever remain better understood; since nature is the experimenter in one case, and man in the other.

PHYSIOLOGY.

7. The sensible world is composed of animate and inanimate beings, which, with their difference in composition and structure, has led to their division into the organic and inorganic or mineral kingdoms.

8. The relations between the two great kingdoms of nature, and their contradistinctions, render a general reference to the inorganic indispensable to our physiological and higher branches of inquiry.

9. Animals and plants, which make up the organic kingdom, are essentially dependent on the inorganic; but the latter kingdom is perfectly independent of the organic.

10. The beginning of organization is in plants, which are the primary source of nourishment to animals.

11. From the foregoing law arises the great fundamental distinction between plants and animals—that the former subsist on the elements of matter, while the latter are nourished by those elements in an organic state. It appears, therefore, that vegetables are more creative than animals (§ 303).

12. All organic substances are compounds of the simple elements of matter. They are combined by the vital powers, while inorganic compounds are produced by chemical forces.

13. As organization begins in vegetables, it is obvious that a decompounded organic substance can be restored to an organic state only by that vegetable kingdom which was created for the specific purpose of organizing the mineral kingdom, for the ultimate final cause of supplying food to animals. The plant reduces, the animal consumes (§ 303).—Notes N R pp. 1121, 1123.

14, *a*. If an animal compound be decompounded, the reunion of the elements into an animal substance requires the agency of both vegetable and animal organization; and, not only so, but nothing can reproduce any given animal compound but the precise part of the same species of animal which gave origin to the part so decompounded (§ 12).—Note R p. 1123.

14, *b*. Owing to this universal law, by which the animal is rendered so perfectly dependent on the vegetable kingdom, the Creator has given a striking perfection to the grand design in the institution of an invisible world of animalcula for the consumption of that vast proportion of organic matter which is passing through the process of maceration to its elementary state. Thus arrested by these economists of nature, it advances through an ascending series of animals, till, at last, it becomes the food of man (§ 151, 1052).

The foregoing distinction is fundamental in nature; and here, at the very threshold, we are met by a barrier which the chemist and

physical philosopher cannot pass from one side, nor the physiologist from the other (§ 1052).

14, *c*. I may also say, that it is no small proof of a Creator, that the elements of all combinations which are generated by animals and plants are derived from the inorganic kingdom, which will be allowed to be less productive than the organic. And since, especially, no organic being can generate any elementary substance, nor the elements unite, of themselves, into organic compounds, it follows that the whole was created by a Being of greater power. We can go no farther back than the elements of matter. Here the atheist himself pauses in dismay. They proclaim a God, and reason submits to this limit of its powers.

I may also propose another, and perhaps greater proof of the error of spontaneous generation. The kingdoms of nature are governed by inherent powers, and the organic possess powers peculiar to themselves; but the existence of matter, whether organic or inorganic, is also indispensable to their respective forces. These forces, therefore, did not create matter; and since matter cannot create matter, and therefore did not create itself, it follows that its associate powers did not create themselves. Whence it is obvious that some greater Power exists by which the powers of nature were created in union with matter (1079 *b*, 1083, 1085).—Notes Pp p. 1142, Qq p. 1145.

These arguments, therefore, may be taken in connection with those which I formerly adduced for the purpose of exposing the fallacy of the doctrine implied by Carpenter, Pritchard, Fletcher, and others, by assuming that the vital properties exist in the elements of matter, and that, therefore, the elements are capable of arranging themselves into organic beings. (See my *Examination of Reviews*, p. 37, and my *Notice of Reviews*. Also, § 1051, 1052.)

15. Exact analyses are readily made of mineral compounds, and the elements may be recombined into the same or other mineral compounds.

The precise analysis of the most simple organic compound, solid or fluid, as fibrin or albumen, is very difficult, and always liable to doubt.

16. Excepting the earths, plants subsist upon the atmosphere and what it contains (§ 303); but they immediately derive much of their nourishment from decaying organic substances that are incorporated with the soil. But, before such compounds can be appropriated by plants, they must be resolved into their elementary state. They can be taken into the organization of plants only in the condition of mineral substances; and even then the most simple binary compound must be decompounded before organization can begin. All the recombinations, as constituting parts in the vegetable economy, are essentially unlike any substance in the mineral kingdom.

17. If animal organization resolve an organic compound into a mineral condition, such compound is useless in the animal economy (§ 13, 14). There is never present, therefore, in the animal organization, as a part of, or as a source of supply to that organization, any mineral substance (§ 360). Whatever mutations the materials of supply may undergo, they must always exist in an organic state, or be permanently restored to the mineral kingdom.—Notes N R pp. 1121, 1123.

18, *a*. We learn from the foregoing premises (§ 17), that food does not lose its organic state during the process of digestion; and since it

becomes more and more nearly assimilated to the living solids from the earliest action of the gastric juice, it is evident that chemical agencies have no connection with the transformations to which it is subjected in the alimentary canal (§ 350–376).

18, *b*. Hence, also, the fallacy of attempting, by chemical analysis, to indicate the proper sustenance of man and animals. "*To determine*," says Liebig, "*what substances are capable of affording nourishment, it is only necessary to ascertain the composition of the food, and to compare it with that of the ingredients of the blood.*" He then proceeds to a practical application of this principle by setting forth the chief elements of the blood. The difficult subject, also, of identifying hay with the flesh of animals, and all the vegetable substances which enter the human stomach with the various tissues of the body, is so far disposed of as to require no other interposition between the nutriment and its conversion into living animal compounds than the chemical forces. This chemical doctrine is thus set forth by Liebig:

"*The most recent and exact researches have established as a universal fact, to which nothing yet known is opposed, that the nitrogenized constituents of vegetable food have a composition identical with that of the constituents of the blood.*"—LIEBIG'S *Animal Chemistry*.

18, *c*. And such, too, is a common example not only of the assumptions of this writer, but of that *positive* manner which has inspired such universal confidence (§ 350¼–350½). There are, of course, in nitrogenized vegetable food certain combinations more or less analogous to what are called the constituents of the blood, though never the same, and but comparatively few in many that are appropriate as means of nourishment; nor could it be doubtful that the elements of the flesh and blood of animals subsisting on vegetables must exist in their food. But the identity of *elements* in any given vegetable and animal compounds is very different from identity of *compounds*, and this, too, with every imaginary latitude of the *isomeric* and *polymeric* problems. Nor have any two chemists agreed, as yet, in their analysis of blood, or of any animal compound (§ 1029, 1030,).

But we have from the laboratory most ample admissions of the groundless nature of the preceding statement. Thus, again, Liebig:

"As far as our researches have gone, it may be laid down as a law, founded on experience, that vegetables produce, in their organism, compounds of proteine; and that out of these compounds of proteine the various tissues and parts of the animal body are developed BY THE VITAL FORCE, *with the aid of the oxygen of the atmosphere and of the elements of water.*

"Now, although it cannot be demonstrated that proteine exists *ready formed* in vegetable and animal products, and although the difference in their properties seems to indicate that their elements are not arranged in the same manner, yet the HYPOTHESIS *of the pre-existence* of proteine, *as a point of departure* in developing and comparing their properties, *is exceedingly convenient. At all events*, it is CERTAIN that the elements of these compounds assume the same arrangement *when acted on by potash at a high temperature*" ! !—LIEBIG'S *Animal Chemistry*.

Nor is this the end of the contradiction; for we also read in the same work, that

"We cannot, indeed, maintain that the animal organism has no

power to form other compounds, for we know that it is capable of producing *an extensive series of compounds, differing in composition from the chief constituents of the blood*" (§ 409, *b*, and 53, *b*).

But, if the foregoing quotations be conclusive of the specific inquiries before us, the following admitted facts not only establish the same conclusions, but prove that chemistry is entirely incompetent to any one of its pretensions as to a *proximate* analysis of the blood, or of other organic compounds, and that it is strictly limited to a mere *elementary* decomposition; while they also concede the existence of a vital principle as an "immaterial" governing power, wholly different from any attribute of inorganic nature, and therefore render it certain in another aspect, that the chemist, from want of this agent, can, at most, only effect the *elementary* analysis of organic compounds. Thus, then, the organic chemist:

"If the problem to be solved by organic chemistry be this, namely, to explain the changes which the food undergoes in the animal body; then it is the business of this science to ascertain what elements must be added, what elements must be separated, in order to effect, or, in general, to render possible, the conversion of a given compound into a second or third; but we cannot expect from it the *synthetic proof of the accuracy of the views entertained, because every thing in the organization goes on* UNDER THE INFLUENCE *of the vital force, an* IMMATERIAL AGENT *which the chemist cannot employ at will.*"—LIEBIG'S *Animal Chemistry.*

18, *d*. If we now turn to section 409, *b*, we shall there find that it is in the blood alone that the reputed proximate principles of vegetables are assumed to exist, and that many proximate compounds are allowed by the chemist to be elaborated from the blood to which there is nothing at all analogous in the vegetable kingdom, or even in the blood itself.

This, then, is the sum of the whole subject: 1st. The chemist has his favorite doctrine of digestion, as an important foothold for materialism, forever present, to be extended as far as the obscurities of the subject will admit, and to borrow an apparent confirmation from these predicated assumptions. The absolute amount of that doctrine is thus expressed by Liebig:

"In the natural state of the digestive process, the food only undergoes a change in its state of cohesion, becoming fluid without any other change of properties."—LIEBIG'S *Animal Chemistry.*

2d. Now, the food undergoing no other change "in the digestive process" than that of becoming "fluid," it is the easiest matter to find it all in the blood just as it was taken into the stomach,—vegetable as well as animal; while, in so finding it, a pretended confirmation is set up of the "universal fact, to which nothing yet known is opposed, that the nitrogenized constituents of vegetable food have a composition identical with that of the blood," and *vice versa*. Or, as Liebig also has it, "vegetables produce in their organism *the blood of all animals*" (§ 350, *no.* 76).

But, 3d. We are assured by chemists, that nothing is more difficult of analysis than the blood, even as it respects its elementary composition; while it is well known that the analyses of this fluid are always discrepant. Hence the impracticability of instituting unexceptionable comparisons between even the elementary composition of

blood and the nitrogenized constituents of plants; while the very nature of the chemical influences exerted upon a vital compound of 17 or 18 elements with a view to its analysis is conclusive of the artificial condition of all the chemical compounds which may be thus formed out of the homogeneous fluid. And *so* LEHMANN, § 1029, 1030.

Again, 4th It is finally said that many substances elaborated from the blood are utterly different from any thing discovered in plants, or in the blood itself (§ 409, *b*). Here, the composition of the organic substances being simple, readily leads to an exposure of the assumptions which have taken refuge under the greater difficulties, and obscurities, and disagreements, attending the analysis of the most complex substance known in nature (§ 53).

18, *e*. But we shall see, farther on, that the chemical school maintain, through their principal chief, those doctrines of digestion, to suit other hypotheses in organic chemistry, which are fundamentally opposed to each other, and which I shall now arrange in connection, that the reader may see, at a glance, not only the speculative nature of organic chemistry, but the feebleness of the assumption as to the identity of the blood and the nitrogenized constituents of plants Thus:

A.	B.	C.
"In the natural state of the digestive process, the food *only undergoes a change in its state of cohesion*, becoming fluid without any other change of properties."—LIEBIG'S *Animal Chemistry*.	"The VITAL FORCE CAUSES A DECOMPOSITION of the constituents of food, and destroys the force of attraction which is continually exerted between their molecules. It alters the direction of the CHEMICAL FORCES in such wise, that the ELEMENTS of the constituents of the food arrange themselves in another form, and combine to produce *new compounds*. It FORCES the *new compounds* to assume forms ALTOGETHER DIFFERENT from those which are the result of the attraction of cohesion when acting freely, that is, without resistance."—LIEBIG'S *Animal Chemistry*.	"The most decisive experiments of physiologists have shown that the process of CHYMIFICATION *is independent of the* vital force; that it takes place in virtue of a PURELY CHEMICAL action, EXACTLY SIMILAR to those processes of DECOMPOSITION or transformation which are known as PUTREFACTION, FERMENTATION, or DECAY."—LIEBIG'S *Animal Chemistry*.

It will be therefore seen by the quotations B and C, that the statement is admitted to be a mere assumption; while it necessarily follows, by adopting either of the contradictory statements, B or C, that the vegetable substances undergo a radical change during the process of digestion, and, therefore, that we cannot find those substances in the blood, but their elements, only, in new and peculiar combinations. The differences, indeed, are probably often much greater than between calomel and corrosive sublimate (§ 350$\frac{1}{4}$).

What, also, gives to the whole of this subject its proper interpretation is the parallel which is drawn by Liebig between the assimilation of the most virulent poisons and the most appropriate food, as set forth in *Section* 350, Nos. 41 and 42. The looseness of the closing sentence of No. 41, abstracted from all the surrounding evidence of hypothesis, is abundantly conclusive of the conjectural nature of the whole of this pretended mathematical demonstration.

There is no difficulty, however, in comprehending the source of the mistake which honest chemists have made in attempting, by

chemical analysis, to indicate the proper sustenance of man and animals. It lies in a wrong conception of the economy of vegetable life, and thence reasoning from a mistaken coincidence of principles, which exist in the two departments of the organic kingdom in a strikingly modified state, to their more analogous results (§ 10, 13–17).—Notes N R pp. 1121, 1123.

Since, however, plants subsist upon mineral substances, in their elementary state, the chemist may often successfully indicate those inorganic or organic compounds which will yield to any given species of plant (whose general elementary composition may be known) the elements that go especially to its nutritive economy. But, from a fundamental distinction between plants and animals (§ 11, 13–17), it is obvious that no such thing can be done in relation to the latter. No better practical proof of this can be wanted than the perfectly indigestible nature of many compounds which contain the requisite elements. Such compounds, upon the chemical philosophy, as I have said, and as admitted by Liebig, include many virulent poisons in the vegetable kingdom, and many inorganic substances whose binary compounds embrace numerous elements. We need not, indeed, go any farther than the recent experiments by Dr. Beaumont upon the varieties of food, as will be subsequently noticed (366), and Magendie's analogous experiments with the food of animals,* to show that the whole of this subject must be left to natural experience.

Nor does it appear to have occurred to the chemical physiologist, in the foregoing inquiries, that the elementary composition of animals is greatly alike, at least in all mammalia. It should follow, therefore, upon the chemical philosophy, that the practical distinctions should not exist between the food of man and animals, but that a common diet should be as universally adapted as atmospheric air. To this conclusion it may be also added, that the same chemical philosophy refers chymification to a purely chemical process; or, in the language of Liebig, "it takes place in virtue of a purely chemical action, exactly similar to those processes of decomposition or transformation which are known as *putrefaction*, *fermentation*, or *decay*."—*Animal Chemistry*, p. 16. And since, therefore, chymification is "independent of the vital force" (*ibid.*), and as chemistry identifies the gastric juice of man and quadrupeds, and even the chyme, it is obvious that chemistry can predicate nothing, upon this subject, of any difference in the vital constitution of man and animals† (§ 409, 350, *d*).

19. In respect to their general structure, inorganic bodies are homogeneous, organic beings heterogeneous. This applies as well to the elementary constituents in their modes of combination as to the compound structure of the whole being. Each particle of a mineral compound is as much a whole as the greater mass, and has the same combination of elements. Each element is as perfect as the compound conditions. Animals have muscles, glands, nerves, vessels, &c., with an endless variety in the elementary combinations in the same individual. All these parts are necessary to make a whole, and depend, mutually, upon each other for their existence. The same

* See Medical and Physiological Commentaries, vol. i., p. 697, &c.

† See my article on the foregoing subject in the Boston Medical and Surgical Journal December 27, 1843.

general principle is applicable to plants. Nevertheless, apparent exceptions occur in both animated kingdoms, as in parts of many plants and of polypi. But, in these instances, each part possesses essentially the whole apparatus of organic life.

20. Organic beings grow from within by interstitial deposition of molecules derived from the blood or sap, according to the exact nature of each part. Inorganic bodies do not grow, but increase only by a superficial juxtaposition of parts, which may, also, be wholly unlike the original crystal, or other nucleus, in their elements.

In the process of growth and nutrition the new material is conveyed within from without, and subjected to many specific changes, till it is resolved into one homogeneous fluid. Atmospheric air is also indispensable to all organic beings. There is nothing analogous in the inorganic world; while these, and an endless series of other facts, establish the similitude of the organic life of plants and animals.

21. A peculiar action of certain agents upon the whole organism of plants and animals, called *vital stimuli*, entirely unlike the action of chemical agents, is necessary to the growth and existence of organic beings. They are both internal and external, and give rise to all the phenomena in organic life, and maintain the whole in one exact condition; while the action of agents upon inorganic, or on dead organic, substances, does not elicit one of these multifarious phenomena (§ 74, 188½).

22. Every part of an animal or vegetable is forever distinguished by the same vital phenomena and physical results; and the action of vital stimuli is forever the same on each part, respectively, but, like the vital phenomena and physical results, different in each; the whole being liable to invariable modifications at different stages of life, and according to temperament, and according, also, to every other modifying influence.

23. Unlike inorganic bodies, organic beings require the coexistence of solids and fluids in their composition.

24. All organic beings have the power of generating motion within all their parts. Mineral compounds have no such endowment. If motion take place in their internal constitution, it depends upon influences which have no existence in living beings. Nor is this all; for motion is always generated in living beings by the operation of a power implanted in their constitution, and this power is brought into action by the mind, and by internal and external physical agents.

25. The solids and certain fluids of organic beings act upon each other. But the fluids act only upon the organic properties of the solids, while the solids transmute the most important fluid into their own substance. The stimulant action of the blood upon the organic properties, and the reaction of the solids upon the blood, are designed for a common end. The concurrence of the whole fabric is necessary to these, as to all other, results. There is nothing analogous in the mineral kingdom.

26. When external or internal agents produce motion in organic beings, they do not affect the composition, in the natural state. It is quite otherwise with inorganic or dead organic compounds.

27. Organic beings are perpetually subject to a vital decomposition and removal of old parts, while the old are exactly replaced by new

ones. It is essential to mineral compounds that they remain without change. Any disturbance of their molecules deranges their structure or composition.

While, therefore, inorganic compounds are forever the same, organic beings are subject to an unceasing loss of identity as respects their present component parts.

28. The external forms of plants and animals are variously and greatly contradistinguished from those of inorganic bodies. The condition of one, also, is uniform; that of the other, even when crystalized, is variable.

29. "The only character," says Müller, "that can be possibly compared in organic and inorganic bodies, is the mode in which symmetry is realized in each; that is to say, the character which minerals possess in their state of crystalization." Yet there is not, in this respect, the slightest analogy; since no true organic compound ever approaches the condition of a crystal. Here we may trust the authority of Liebig, who says of the "vital principle of the animal ovum, as well as the seed of a plant," that,

"Entering into a state of motion or activity, it exhibits itself in the production of a series of forms, which, although occasionally bounded by right lines, are yet *widely distinct* from *geometrical* forms, such as we observe in crystalized minerals. This force," he goes on, "is the vital force, vis vitæ, or vitality."

30. The foregoing considerations, each and all (§ 8–29), demonstrate a radical difference between the forces and laws of organic and inorganic beings, and a remarkable modification of such as are common to plants and animals. But, as the institutions of organic life lie at the foundation of medical science, they should be still farther sought in the contradistinctions between the organic and inorganic kingdoms, and in those diversified phenomena which indicate a common but modified government of animals and plants. All organic beings possess in common the most essential conditions of life, though existing in the two great departments of living nature under specific modifications or varieties; not, however, very dissimilar, but intimately connected by a gradation of analogies, as we descend along the chain of either, till we arrive at their more absolute connecting link in the lowest being of one and the other. Other conditions are superadded to the nobler department, which, with the differences of structure and the modifications of their common properties of life, and their modes of subsistence, distinguish the two living kingdoms from each other.

31. Physiology may be divided into, 1st. The composition of organic beings; 2d. Their structure; 3d. Their properties; 4th. Their functions; 5th. Modifications of properties and functions which arise from sex, temperament, climate, habits, age, &c.; 6th. The relations of organic beings to external objects; 7th. Death.

These several topics will be considered with a special view to the great principles which form the Institutes of Medicine.

FIRST DIVISION OF PHYSIOLOGY.

COMPOSITION.

32. The principal object contemplated by this work in ascertaining the facts relative to the *composition* of organic beings is to settle the principles and laws upon which such beings are constituted, by tracing them out in the fundamental conditions of organic matter.

33. Composition is subdivided into ultimate or elementary, and the proximate parts; the latter being compounded of the former.

34. Of the sixty-six known elementary substances, the following seventeen have been found in the composition of plants: carbon, oxygen, hydrogen, nitrogen, potassium, calcium, iron, manganese, phosphorus, sulphur, silicium, magnesium, aluminum, chlorine, sodium. iodine, bromine.

35. The same elements (34), with the addition of fluor, and the probable exception of aluminum, occur in animals. Arsenic is also often found in man.* Although animals are exposed to various sources from which other elements might be derived, they reject every other elementary principle; or, rather, are incapable of their assimilation.—Notes N R pp. 1121, 1123.

36. The foregoing coincidence in the common nature of the elements of plants and animals supplies no small proof of the peculiar properties and laws of organic beings. Others, however, more striking, lie at the foundation, and form, also, contradistinctions with the inorganic world.

37. Animal and vegetable substances are mostly composed of carbon, oxygen, hydrogen, and nitrogen, four out of the sixty-six elements that go to the formation of inorganic compounds. The main bulk of plants, indeed, such as the cellular and vascular tissues, is probably composed of carbon, hydrogen, and oxygen alone, as the essential elements; though nitrogen is indispensable to many of the products of vegetable organization, and Liebig says it is found in all parts of a plant (§ 62, *f, note*). The three or four indispensable elements compose 90 or more parts of 100 of all the soft textures of animals, and of all plants. These are selected, universally, by the vegetable kingdom, as if by instinct. This circumstance increases greatly the force of the conclusion in the foregoing section (§ 36).

38. The elements of mineral compounds are always united in a binary manner; those of organic in a ternary, quaternary, &c., being always intimately blended with each other. This distinction involves an absolute difference in the powers and laws of the two kingdoms.

39. No two elements, therefore, can form a true organic compound. The rare exceptions which have been made by the chemists are not organic substances, nor can they be rendered such by the animal organization. They belong to the mineral kingdom, from which they cannot be elevated but by the properties of vegetable life (§ 14, 16, 17).

All mineral compounds may be resolved into their elements, which are as perfect minerals as when united. Indeed, the most natural condition of a mineral is the state of a simple element.

* Whence come the fluor and the arsenic, unless through plants? (§ 14–18.)

40. What, therefore, is so fundamental in organic beings as expressed in sections 38 and 39, and universally admitted, allows of no introduction of powers, principles, laws, &c., which shall conflict with the powers and laws upon which the simplest organic compound is constituted.* In the progress of this work it will be seen that this position is every where substantiated. Unity and harmony prevail throughout each department of nature, respectively; and while the powers and laws of the organic are as fully contradistinguished from those of the inorganic kingdom as are their physical and all other attributes, we shall find that the former are apparently embarrassed by a great diversity of phenomena as manifested in health and disease, but that, in reality, all the variety goes to the conclusion that the fundamental principles are the same throughout (§ 638, 733, *d*).

41. Again, we may suppose at least some 20,000,000 of distinct organic compounds in the various species of plants, and some 30,000,000 more in the animal kingdom, formed greatly out of four elements (§ 37), while these same elements yield scarcely a dozen combinations in the mineral kingdom.

42. The foregoing organic compounds are formed in each individual, respectively, out of one common homogeneous fluid, composed of about seventeen elements. No chemical hypothesis can interpret this universal characteristic of the organic kingdom; while all the relative facts of inorganic chemistry are totally opposed to this almost endless and undeviating variety of new combinations out of a common fluid, according to the species of animal or plant, and according to the nature of every particular part. If chemical agencies operated, there would be no uniformity in any secreted product at any two successive moments (§ 741, *b*, 1052).

It is one of the frequent concessions of the distinguished chemico-vitalist, Müller, that

"The opinion that the component principles of the organs exist in the blood in their perfect state cannot be possibly adopted. The components of most tissues, in fact, present, besides *many modifications* of fibrin, albumen, fat, and ozmazome, *other perfectly peculiar* matters, nothing analogous to which is contained in the blood." "Even the fibrin of muscle cannot be considered identical with the fibrin of the liquor sanguinis."—Müller.—So, also, Lehmann, § 1029–1031.

John Hunter also laid down the following doctrine, as expressed by his editor, Mr. Palmer:

"It is highly probable that the different proximate principles of vegetable and animal substances hold different ranks in the scale of organized substances, in the same manner that one animal ranks higher in the scale of organized beings than another."—Hunter.

And thus Liebig, as a *vitalist*, in opposition to himself, as a *chemist:*

"In that endless series of compounds, which begins with carbonic acid, ammonia, and water, the sources of the nutrition of vegetables, and includes the most complex constituents of the animal brain, there is NO BLANK, NO INTERRUPTION. THE FIRST SUBSTANCE CAPABLE OF AFFORDING NUTRIMENT TO ANIMALS IS THE LAST PRODUCT OF THE CREATIVE ENERGY OF VEGETABLES."—Liebig's *Animal Chemistry.*

* Since the foregoing sentence was written, the new doctrine of the "Correlation of Physical and Vital Forces" has induced Chemistry to exalt a multitude of its fabrications out of inorganic substances to the condition of organic compounds. But this will probably soon "mark a past epoch in Organic Chemistry." See Note Fff p. 1150; also Lehmann, p. 779-782.

43. Although it be generally true that it is the wonderful province of organization to elect only four elements from the homogeneous fluid (§ 42) in the formation of organic compounds, yet there are some compounds which embrace a greater number, though unlike the elements of inorganic compounds, in intimate union with each other (§ 38). The blood, indeed, has not less than seventeen or eighteen elements thus united; a circumstance in itself conclusive that other powers than the chemical must preside over the elaboration of the very limited number of elements that go uniformly to the formation of all other organic compounds. And, although the metallic and earthy substances form no part of the essential organs of life, they are yet vitally united with the indispensable organic compounds in particular parts, and are elaborated from the blood or sap by those parts only, and with an astonishingly relative proportion to the other elements, as sulphur by the brain, phosphate of lime by the bones, fluate of lime by the teeth, phosphate of magnesia by wheat, silex by the stem of wheat, and by the skeletons of many poriferi, &c. We shall not regard these substances as accidental, or as introduced by a physical process, but, as contributing a subordinate part with the essential organic elements toward the perfection of an unfathomable system of Designs, whose moving power is only short of the Creative Energy, in being substituted for that Great First Cause, with limitations that chain it to the fulfillment of secondary ends (§ 847).

44. Organic compounds are forever the same, in health, in any given part of any species of being at each stage of existence, but liable to be more or less modified in an exact manner at the several stages (§ 153–159).

And so of disease. The same morbid state of any given part, *cæteris paribus*, always produces the same modifications of the organic compounds of which it may be composed, the same alterations of the secreted fluids, and the same new formations. All this is distinctly seen in the phases of scrofula, in small-pox, cow-pox, lues, measles, hydrophobia, &c.

It is opposed to all facts, that any chemical influences can decompound a fluid composed of seventeen or eighteen elements, not only in the exclusive manner represented in the last section, but according, also, to the exact vital constitution or vital modification of each part.

45. Nevertheless (§ 44), the general composition of animals is the same, whether they subsist upon grass, or flesh, or whatever be the nature and variety of the food. So of the chyme, the chyle, and the blood. There is nothing in chemistry that will throw any light upon these coincidences (§ 18, 409).

46. Contrary to what has been seen of the variety of organic compounds out of four simple elements (§ 41), only a few hundred, at most, of distinct inorganic compounds can be formed out of the 66 elements which compose the mineral kingdom (§ 37). Those few compounds, however, make up the great mass of the globe, while the organic are only scattered over its surface. Nor is there a globe in the universe that would not be as worthless as space, did it not administer to the purposes of life.

47. Different combinations of carbon, oxygen, hydrogen, and nitrogen, constitute, mainly, the whole vegetable and animal materia medi-

ca; while their inorganic compounds do not contribute one remedial agent of any importance.

48. It is evident that the four principal elements of organic compounds combine not only in different proportions, but so variously, in respect to the proportions, among themselves, as to bewilder the imagination (§ 41). Chemistry can give us no light upon these subjects but what is purely analytical; while, in respect to their mineral compounds, the same elements unite only in a small number of proportions, upon which chemistry throws its light with a brilliancy that may be said to penetrate the unfathomable recesses of their organic compounds. This fundamental distinction is necessarily conceded; and it were well for science if chemistry did not overstep the limit. But, the chemist shall always speak for himself. Thus Liebig:

"6 eq. *tartaric acid*, by absorbing 6 eq. oxygen from the air, form *grape sugar*, with the separation of 12 eq. carbonic acid. We can explain, in a similar manner, the formation of all the component substances of plants, which contain no nitrogen, whether they are produced from carbonic acid and water, with separation of oxygen, or by the conversion of one substance into the other, by the assimilation of oxygen and separation of carbonic acid. *We do not know in what form the production of these constituents takes place.* In this respect the *representation* of their formation which we have given *must not be received in an absolute sense, it being intended only to render the nature of the process more capable of comprehension.* But, it must not be forgotten, that, IF the conversion of tartaric acid into sugar, in grapes, *be considered a fact*, it must take place under all circumstances *in the same proportions*" !—LIEBIG'S *Organic Chemistry applied to Physiology.*

The reader should never lose sight of the foregoing hypotheses and admissions. They should be ever ready to chasten his credulity as to the chemical interpretation of every organic compound. They stamp the whole "science of organic chemistry," in its synthetical aspects, as one of pretension, and unworthy the confidence of an intelligent mind (§ 350–350¾).

And this is farther confirmed by the statements in the two next following sections.

49. "The particles of matter," says Liebig, "called equivalents in chemistry, are not infinitely small, for they possess a weight, and are capable of arranging themselves in the most various ways, and of thus forming innumerable compound atoms. The properties of these compound atoms differ in organic nature, not only according to the form, but, also, in many instances, according to the direction and place which the simple atoms take in the compound molecules.

"When we compare the composition of organic compounds with inorganic, we are quite amazed at the existence of combinations in one single molecule, of which ninety or several hundred atoms or equivalents are united. Thus, the compound atom of an organic acid of very simple composition, acetic acid, for example, contains 12 equivalents of simple elements; 1 atom of kinovic acid contains 33; 1 of sugar, 36; 1 of amygdalin, 90; 1 of stearic acid, 138 equivalents. The component parts of *animal* bodies are *infinitely more complex* even than these."—LIEBIG'S *Organic Chemistry*, &c.

50. "Inorganic compounds differ from organic in as great a degree

in their other characters as in their simplicity of constitution. Thus, the decomposition of a compound atom of sulphate of potash is aided by numerous causes, such as the power of cohesion, or the capability of its constituents to form solid, insoluble, or, at certain temperatures, volatile compounds with the body brought into contact with it; and, nevertheless, a vast number of other substances produce in it not the slightest change. Now in the decomposition of a complex organic atom *there is nothing similar to this.*"—LIEBIG'S *Organic Chemistry*, &c.

51. "An essential distinction between organic and inorganic compounds is, that in organic products the combining proportions of their elements do not observe, as in mineral compounds, a simple arithmetical ratio."

52. An interesting corollary flows from the foregoing facts (§ 22, 41–50), namely, that all animal and vegetable poisons, all remedial agents of an organic nature, and all the varieties of food, depend upon the mode and proportions in which a few particular elements unite with each other. It is evident, also, from § 41, that no two remedial agents generated by different species of plants or animals, however similar, can be exactly alike in their morbific or remedial virtues. Hence the differences among cathartics, emetics, &c. As composition, especially of the sap, also varies more or less at the different ages of plants and at different seasons, and also from unhealthy conditions, so will corresponding differences arise in their remedial and morbific virtues. In all the cases, however, the characteristics of organic products as vital agents are uniformly the same under any given condition of the organic being; and so of each simple element, and of the physiological effects of all vital agents (§ 188½, *d*). The precise natural or morbid states of the organic properties lie at the bottom of the whole philosophy, since these properties, through their instruments of action, combine the elements exactly according to their existing state (§ 650, 741 *b*, NOTE FFF p. 1150).

53, *a*. From the facts now stated (§ 38–51), it is evident that the organic chemist can do no more than effect an analysis of organic compounds. He can only present each simple element by itself, without the possibility of acquiring a knowledge of the modes and proportions in which they combine with each other.

53, *b*. So, also, if the aggregate compounds, such as blood, sap, muscle, gastric juice, &c., be, in reality, made up of more simple compounds, or "proximate principles," by the union of compound atoms, chemistry can give us no information as to the conditions in which they naturally exist. Those combinations which are most alike are different from each other in every distinct part of the organic being, and different in the same parts of distinct species. This is so from the first development of the germ; and what is then begun is perpetuated through the life of the individual, and transmitted to all succeeding generations (§ 63–81, 155). The differences, as we have seen, result from the different proportions in which some three or four principal elements are united together, and from the proportions of different compound atoms which may enter into the entire combination, and from the manner in which they and their elements are combined among themselves. It must be obvious, therefore, that we can never reach the secret of these combinations. We should neces-

sarily expect, even from the shades of elementary distinctions, that chemistry would confound and even identify many compounds that are totally unlike in their nature. And this it actually does, in presenting to us sugar, vinegar, starch, gum-arabic, wood, &c., as the same substance; and in identifying pus and cheese, and, again, the albumen of eggs, lymph, mucus, and the product of certain cancerous affections. Nor is there generally any agreement among the chemists in their analyses of organic compounds. It is as true now, as when Bostock (a chemical physiologist) affirmed, that "every subsequent attempt to discover the *elements* of organized substances differs more or less from those that preceded it" (§ 1029, 1030).

The moment chemical agencies begin their operation, artificial transformations necessarily ensue, and the nature of the organic compound is changed in a corresponding manner. A large proportion of the resulting products are perfectly new formations, particularly all the binary compounds (§ 38, 39). Nor can there be any doubt that the reputed "proximate principles" are intimately incorporated in any given compound, and have no such separate existence as chemistry teaches. It lies at the very basis of chemistry, that all the elaborations are the artificial results of affinities which have been set in motion by the agents employed, and which are employed for that very purpose. This I have already endeavored to demonstrate in the *Medical and Physiological Commentaries* (vol. i., p. 674–682), even so far as to show that urea may not be formed by the kidneys, but is the result of spontaneous changes after the elaboration of urine, as it is of artificial influences (§ 54, *a*). But, attentive observation will generally detect the chemist in the admission of facts which are subversive of his speculative doctrines (§ 18, 350); and so it is in the case before us. The admission covers the whole ground as to the pretensions of organic chemistry beyond the most simple elementary analysis. Thus (NOTE FFF p. 1150),

53, *c*. "Were we able to produce taurine and ammonia directly out of uric acid or allantoine, this might perhaps be considered as an additional proof of the share which has been ascribed to these compounds in the production of bile. It cannot, however, be viewed as any objection to the views above developed on the subject, that with the means we possess, we have not yet succeeded in effecting these transformations out of the body. Such an objection loses all its force, when we consider that we cannot admit, as proved, *the pre-existence of taurine and ammonia in the bile; nay*, that IT IS NOT EVEN PROBABLE that those compounds, which are only known to us AS THE PRODUCTS OF THE DECOMPOSITION OF THE BILE, *exist ready formed, as ingredients of that fluid*. By the action of muriatic acid on bile, we, in a manner, FORCE ITS ELEMENTS TO UNITE IN SUCH FORMS as are no longer capable of change under the influence of the same re-agent." —LIEBIG'S *Animal Chemistry*.

By the admissions, also, in § 18, 42, and 350, it will be seen that the Utopian nature of organic chemistry is equally established in all its pretensions by its own founders and advocates (§ 1030).

54, *a*. Organic substances alone undergo fermentation and putrefaction; and this shows us, also, in the language of Tiedemann, that "even when the life of organic bodies is extinct, we should consider the qualities which they possess, from the time of death to the com

plete resolution of organization, as the result of the vital powers which have been active in them."

This obvious principle conducts us at once to the whole philosophy of those numerous transformations of which organic compounds are susceptible from chemical agencies, while they still retain their elementary combinations, and appear under uniform aspects when subjected to the same chemical influences, and often analogous to the natural condition of the compound. "It is the power of formation," says Tiedemann, "which, after the extinction of the individual life of organized bodies, renders the organic matters, separated from their organization, capable, provided they have not been reduced to their elements by external physical or chemical actions, of assuming new and more simple forms, according to the diversity of external influences, such as heat, light, water, &c., which determine them in taking on this new form. This power appears, therefore, to be a property inherent in organic matters in general, rendering them able to take other more simple configurations when detached from the combinations of living bodies" (§ 1029, 1030).

Some organic compounds undergo transformations of the foregoing nature as soon as separated from the organic being. The homogeneous blood is immediately reduced into three principal compounds, which have no natural existence as such. Nor is this all; for there is a fundamental change among the elements and the compound atoms of the entire mass. The changes arise from the loss of the vital properties, and the subsequent operation of chemical influences. Such, too, is the constitution of organic compounds that there may be a remarkable uniformity in the resulting products when the same chemical agents operate upon any given compound; as exemplified in the various transformations to which sugar is liable, and as seen in the uniform production of morphia, narcotina, quinia, cinchonia, &c.

54, *b*. It is obvious, however, from the premises which I have set forth, that chemistry can, at most, present but a few compounds as apparently distinct from each other in their elementary composition; for, although there are many millions of these distinct combinations in organic beings (§ 41), they commonly possess such analogies that chemistry is obliged to confound all but a few which have strong characteristics. These few, which are denominated *proximate principles*, are supposed by the chemist to make up the entire composition of organic beings. But, a greater proportion even of these few are so inscrutably different from each other in their elementary combinations, that they are classed under common denominations, not only for the foregoing reason, but on account of certain resemblances in their physical properties; while it is by these last, and by their differences in results as vital agents, we come to know that broad distinctions may exist among them. Such, for example, are the various acids, oils, resins, &c.—NOTE FFF p. 1150.

55. All organic substances, while endowed with life, resist the decomposing influences of all surrounding agents. All inorganic compounds yield to these influences.

56. As soon as organic beings are dead, the very agents that had contributed to their growth and nourishment now become the causes of breaking up their elementary combinations, and with a rapidity unknown in the ordinary decomposition of mineral compounds. In the

former case, it is allowed by Liebig, that the "VITAL PRINCIPLE OPPOSES to the continual action of the atmosphere, moisture, and temperature, upon the organism, a resistance which is in a certain degree *invincible.*"

57. In the seed and ovum the properties of life are in a state of action which maintains their elementary combinations against the chemical forces. They resist degrees of cold which operate destructively upon their composition when their life is extinct. Those agents, too, as heat and moisture, which speedily resolve the egg and seed, when deprived of life, into their ultimate elements, will in the same degrees of intensity develop from the germ, when alive, a perfectly organized being. In the former case the operation of the principle of life is generally mistaken for "*a force in a state of rest.*" Thus, Liebig:

"In the animal ovum, as well as in the seed of a plant, we recognize A CERTAIN REMARKABLE FORCE, the SOURCE of growth, &c., *a force in a state of rest.*"—LIEBIG'S *Animal Chemistry, first sentence.* See, also, my *Examination of Reviews*, p. 7–28.

58. It follows, therefore, that the power which resists the decomposing forces and agents in living beings combined the elements of such beings, and that death is an extinction of that power. The chemical forces can have no connection with the combinations, since they are held together by a power in direct opposition to chemical influences.

What, therefore, unites the elements and maintains them against the action of chemical agents, being the fundamental power, must necessarily preside over all the processes and results to which organic beings are liable.

59. "The elements of dead organic matter," says Liebig, in his Organic Chemistry, "seem merely to retain *passively* the position and condition in which they had been placed." "The atoms exist only by the *vis inertiæ* of their elements." So, also, Mülder, § 350$\frac{3}{4}$, *n*, and other chemical physiologists. This shows that the original union is effected by other powers than the chemical, which, otherwise, would still operate after death, and prevent decomposition. We also thus learn why dead organic compounds so readily undergo fermentation and putrefaction, and from the slightest influences. All of which, indeed, appears to be abundantly conceded by the chemical philosopher when he yields to the force of facts. For what can be more ample than Liebig's affirmation, that

"The VITAL FORCE is manifested in the form of RESISTANCE, inasmuch as by its presence in the living tissues, THEIR ELEMENTS *acquire the power of withstanding the disturbance and change in their form and* COMPOSITION, *which external agents tend to produce; a power, which, as chemical compounds, they do not possess.*"—LIEBIG'S *Animal Chemistry.*

And yet again may I press into the service of truth the organic chemist, when he temporarily loses sight of the laboratory, and contradicts those speculations which impart to his writings the zest of novelty. In his *Lectures* for the winter of 1844, Liebig appears to have been alarmed for the safety of his empire, and we have here an unusual amount of "*vitality.*"

The work on *Animal Chemistry applied to Pathology and Thera-*

peutics was more of a distillation from the laboratory than its predecessor, *Organic Chemistry applied to Physiology;* and, as many of the most eminent physiologists in Europe, who were inclined to mingle chemistry with vitalism, were nauseated by the dose which was last administered, Liebig came out in his *Lectures* with the following placebo for the vitalists, and the chemico-vitalists. Were it not contradicted by the lecturer, it should place him in the very front rank of vitalism. The doctrines are of the most fundamental nature, and lie at the basis of these Institutes, and of my "Medical and Physiological Commentaries." It will be seen that they are strictly relative to my present subject, and inculcate all that the most transcendental vitalist can desire as to the *distinct nature of the vital principle, its full control over the processes of life, its extinction at death, and an absolute distinction between vital and chemical processes and results, while those processes and results are, respectively, referred to forces of a totally distinct nature.* Thus:

"After the EXTINCTION of the vital principle," says Liebig, "in organic atoms, they maintain their form and properties, the state into which they have been brought in living organisms, *only by reason of their inherent inertia.* It is a great and comprehensive law of matter, that its particles possess no self-activity, no inherent power of originating motion, when at rest; motion must be imparted by some external cause; and, in like manner, motion once imparted to a body can only be arrested by external resistance.

"The constituents of vegetable and animal substances having been formed under the guidance and power of *the vital principle,* it is this principle which determines the direction of their molecular attraction. The vital principle, therefore, must be A MOTIVE POWER, capable of imparting motion to atoms at rest, and of opposing resistance *to other forces* producing motion, such as the chemical force, heat, and electricity. We are able to reliquefy and redissolve albumen, after it had been coagulated by heat, but *the vital principle* ALONE is capable of restoring the original order and manner of the molecular arrangement in the smallest particles of albumen. Coagulated albumen is again converted into its original form, it is transformed into flesh and blood in the animal organism.—NOTES N R pp. 1121, 1123.

"In the formation of vegetable and animal substances, *the vital principle opposes,* as a force of resistance, the action of the other forces,—cohesive attraction, heat, and electricity,—forces which render the aggregation of atoms into combinations of the highest order impossible, except in living organisms.

"Hence it is, that when those complex combinations which constitute organic substances are withdrawn from the influence of the vital force,—when this no longer is opposed to the action of the other disturbing forces, great alterations immediately ensue in their properties, and in the arrangement of their constituents. The slightest chemical action, the mere contact of atmospheric air, suffices to cause a transposition of their atoms, and to produce new arrangements; in one word to excite *decomposition.* Those remarkable phenomena take place which are designated by the terms FERMENTATION, PUTREFACTION and DECAY; these are the processes of decomposition, and their ultimate results are to reconvert the elements of organic bodies into that state in which they exist before they participate in the processes of life."

The reader, however, will be more astonished to learn that he has not discovered, amid the multitude of conflicting statements and doctrines, a passage in the work on *Animal Chemistry* which, even more than the preceding, identifies "the *Reformer*" with the most exclusive vitalists, and completely annuls all his chemical and physical speculations as to organic life, and his radical distinctions between plants and animals (§ 350, nos. 12, 15, 20). It will be also seen with what pretense he has been denominated "*the Reformer*," and "*the author of a new and the greatest era in physiology.*" The extract inculcates the doctrines of an independent vital principle, its identity in plants and animals, the action of stimuli upon that principle, its susceptibility of influences from the nervous power in animals, the absence of that influence in plants, and the dependence of all organic processes and results, equally in plants and animals, upon that principle.

Now these are exactly the doctrines which are also fundamental throughout the Medical and Physiological Commentaries and these Institutes. They are relative to the constitution and processes of organic beings as a whole, while the foregoing quotations from Liebig's Lectures comprehend the principles by which I have interpreted the elementary condition of organic bodies. Thus our author:

"*The activity of vegetative life manifests itself, in* VEGETABLES, *with the aid of external influences;* IN ANIMALS, *by means of influences produced within the organism. Digestion, circulation, secretion, are, no doubt, under the influence of the nervous system; but* THE FORCE *which gives to the germ, the leaf, and the radical fibres of the vegetable* THE SAME WONDERFUL PROPERTIES, *is the* SAME *as that residing in the secreting membranes and glands of animals,* and which enables every animal organ to perform its own proper functions."—LIEBIG'S *Animal Chemistry.*

60. "The diversity of the transformations and of the resulting products," says an able advocate of Liebig's physical doctrines of life, "indicate most certainly the complexity of an organic product" (§ 41). "The metamorphoses which occur after organic substances are removed *from the influence of the vital force*, constitute a separation, or splitting up into new and less complex compounds" (§ 54).—MR. ANCELL, *in London Lancet, Nov.* 26, 1842.

Thus, again and again, does the chemical physiologist unavoidably concede that the elements of organic beings are held together by a vital principle, and, therefore, that they are originally united by that principle.—NOTE FFF p. 1150.

Vitalism becomes established in all its aspects, even in what has been denominated "transcendental vitalism," when it may be shown that the elements of organic beings are, in the language of Liebig, "*united by a peculiar mode of attraction, resulting from the existence of a power distinct from all other powers of nature, namely, a Vital Principle;*" since, as I have said, the powers and laws which regulate the composition must be at the foundation of all the subsequent results. Concessions of fundamental principles overthrow all opposing "facts," and all secondary doctrines of a conflicting nature. These, therefore, may be advantageously connected with demonstrations of the truth. There are few intelligent minds that do not rightly appreciate those grand phenomena of Nature which conduct us to

a knowledge of her fundamental laws, or do not incidentally betray their conviction of the right, however the enticements of fame may beguile them into ingenious substitutions. I shall, therefore, as on all former occasions, continue to bring to the aid of my conclusions the powerful concessions of the most eminent men who belong to the adverse schools in organic philosophy. It is manifest that such authorities must weigh with the force of demonstration, since it is obvious that their admissions can flow only from convictions that have been obtained in the school of Nature. Among the most illustrious of the adverse school is Liebig, and standing intermediate is the profound and erudite Müller. And having thus referred again to this great philosopher, I will not lose the opportunity of obtaining from him an important contribution to the doctrines of vitalism as they relate to the very composition of organic beings, and in which he institutes a broad contrast between the affinities which unite the elements of organic and inorganic compounds. Thus:

"Chemical substances," says Müller, "are regulated by the *intrinsic* properties and the elective affinity of the substances uniting to form them. In organic bodies, on the contrary, the power which induces, and maintains, the combination of their elements, does not consist in the *intrinsic properties* of those elements, but in *something else*, which not only *counteracts* those affinities, but effects combinations in *direct opposition* to them, and *conformably* to the laws of its own operation."—MÜLLER, *Elements of Physiology*, p. 4.

Liebig, also, variously inculcates the same great principle. Take, in the first place, a demonstration the converse of Müller's. It is the last paragraph in the work on Organic Chemistry. Thus:

"The same *numerous causes* which are opposed to the formation of complex *organic molecules*, under ordinary circumstances, *occasion their decomposition and transformations* when the only ANTAGONIST POWER, THE VITAL PRINCIPLE, NO LONGER COUNTERACTS THE INFLUENCE OF THESE CAUSES. New compounds are formed in which CHEMICAL AFFINITY HAS THE ASCENDENCY, and opposes any farther change, while the conditions under which these compounds were formed remain unaltered."

Again, we are informed by this chemist, that

"The equilibrium in the chemical attractions of the constituents of food is disturbed by the VITAL PRINCIPLE, as we know it may be by many other causes. But the union of the elements, so as to produce NEW COMBINATIONS *and forms*, indicates the presence of A PECULIAR MODE OF ATTRACTION AND THE EXISTENCE OF A POWER DISTINCT FROM ALL OTHER POWERS OF NATURE, namely, the VITAL PRINCIPLE." "If the food possessed life, not merely the chemical forces, but THIS VITALITY would offer resistance to the VITAL FORCE of the organism it nourished." "The individual organs, such as the *stomach*, cause all the organic substances conveyed to them, which are capable of transformation, to assume new forms. The stomach *compels* the *elements* of these substances to unite into a compound fluid for the formation of blood."—LIEBIG'S *Organic Chemistry*, p. 356, 357, 346, 384.

61. It is a remarkable characteristic of organic beings that they are composed chiefly of combustible substances, properly so called, and a supporter of combustion; with the principal exception of that anomaly in the inorganic kingdom, nitrogen gas (§ 37).

62, *a*. The general introduction of nitrogen gas into the constitution of animal compounds, and into many of a vegetable nature, while it is excluded from mineral compounds, is one of the most striking distinctions between the two kingdoms of Nature. Upon that distinction I have founded an argument, in my Essay on the "Philosophy of Vitality," in proof of the difference in the powers and laws by which the two kingdoms are governed. It appears also appropriate to this work that the proof should be here introduced.

62, *b*. I have said in the foregoing Essay, that it is abundantly evident that living beings are endowed with properties which protect their elementary composition against all those decomposing agencies which are perpetually separating the elements of all mineral compounds. This shows that the properties, by which the elements of living beings are united, are utterly different from such as combine the elements of inorganic compounds. Nevertheless, the living organization is undergoing a systematic change, a perpetual decomposition, surpassing any mutations that are in progress in the surrounding world. These decompositions are, also, of a peculiar nature, governed by established laws, various in different parts of the same individual, yet forever the same in any given part (§ 44). I shall not stop to show how the old are replaced by new materials, and how the processes go on *pari passu*, and in opposition to all the philosophy which chemistry teaches, but only say that the decompositions must be effected by properties as peculiar to the living compound as are the results; and that these results conspire with the peculiar modes in which the elements are combined in proving the existence of specific properties, which are the common cause of all the harmonious phenomena of living beings (§ 38–42).

62, *c*. When, however, the organic being dies, a new order of decomposition begins, eminently of a chemical nature, and in forcible contrast with that which concerns the vital process of renewal. This is due to the special element, nitrogen gas, which may be called the *principle of dissolution*. Wherever present, it gives rise to transformations and disunion of all the other elements after the properties of life have lost their sway. The moment these cease, chemical decomposition begins,—confusedly, violently; and such are the nature and combinations of the elements, that their disruption would go on with no other contribution from surrounding agents than water alone. Hence the more rapid transformations and dissolution of animal than of vegetable tissues, and of sap and other substances which are generated by vegetable organization.

62, *d*. Liebig says of nitrogen gas, that "there is some peculiarity in its nature, which gives its compounds the power to decompose spontaneously with so much facility. Now, nitrogen is known to be the most indifferent of all the elements. It evinces no particular attraction to any one of the simple bodies, and this character it preserves in all its combinations; a character which explains the cause of its easy separation from the matter with which it is united." And again, "When those substances are examined which are *most prone* to fermentation and putrefaction, it is found that they are all, *without exception*, bodies which contain nitrogen."—Liebig's *Organic Chemistry applied*, &c., p. 241.

62, *e*. In the inorganic kingdom, nitrogen is mostly confined to the

atmosphere, where it probably exists in a state of simple intermixture with oxygen. "All bodies which have an affinity for oxygen abstract it from the atmosphere with as much facility as if the nitrogen were absent altogether;" and we have striking examples of the disposition of nitrogen to separate from its compounds, "in the easy transposition of atoms in the fulminating silvers, in fulminating mercury, and in all fulminating substances," whose ready explosion is owing to the presence of nitrogen. "All other substances," says Liebig, "containing nitrogen acquire the same power of decomposition when the elements of water are brought into play."

62, *f*. Now the foregoing characters belong to nitrogen only as it exists in inorganic or in dead organic compounds, while the former, also, are artificial, or due to accidental causes. In living beings, where it abounds,* it adheres to its associated elements with a tenacity which no agent can impair till it destroys the life of the part; or, in other words, till it destroys those vital properties by which the elements were truly united. It is then, however, that the forces of chemistry take possession, and the elements may explode, I had almost said, with the facility of the fulminating compounds.

62, *g*. "There is," says Liebig, "in the nature and constitution of the (inanimate) compounds of nitrogen, a kind of tension of their component parts, and a strong disposition to yield to transformations, which effect spontaneously the transposition of their atoms *on the instant* that water or its elements are brought in contact with them." On the contrary, "it is found that no body destitute of nitrogen possesses, when pure, the property of decomposing spontaneously while in contact with water."—LIEBIG.

But, although dead animal compounds readily pass into spontaneous decomposition under slight degrees of moisture, yet, composed as they are, in part, of the elements of water, and very largely impregnated with aqueous substances in their living state, neither those elements, this water, nor any other agent, can disturb the exact combinations.

But, when the organic being dies, chemical agencies have their play, and it is then that

"The result of the known transformations of substances containing nitrogen proves," according to Liebig, "that the water does not merely act as a medium in which motion is permitted to the elements in the act of transposition, but that its influence depends on chemical affinity. When the decomposition of such substances is effected with the assistance of water, the nitrogen is invariably liberated in the form of ammonia."—LIEBIG.

In respect to the inorganic world, had nitrogen been incorporated in its compounds, there would have been no stability among them. They would have been perpetually undergoing decomposition, until finally the whole of the nitrogen would fly off by itself, and nothing of the original compound would remain; and it could never be recombined.

62, *h*. Besides the disposition of nitrogen to tear asunder the ele-

* Nitrogen is well known to abound in all the tissues of animals. Of vegetables, Liebig says, that, "Estimated by its proportional *weight*, nitrogen forms only a very small part of plants, but it is never entirely absent from *any part* of them. Even when it does not enter into the composition of a particular part or organ, it is always to be found in the fluids which pervade it."—LIEBIG'S *Organic Chemistry applied to Physiology*, &c., p. 4.

ments with which it may be combined, the complexity of these elements in organic beings contributes to the disorganizing results after death, and is another principal cause of spontaneous fermentation and putrefaction (§ 38, 41, 46, 48, 52, 53).

62, *i*. From the foregoing facts, especially from the universality and fixedness of nitrogen in organic beings, I arrive at the conclusion that the elements of their compounds are united by forces as peculiar as the facts which relate to these compounds, and that the forces of chemistry have no agency in combining the elements, or in effecting changes of their combinations during life. It is also abundantly manifest from my premises, that Liebig's declaration that "by chemical agency we can produce the constituents of muscular fibre, skin, and hair," is without the slightest foundation (§ 12, 13, 14).

62, *k*. The whole labyrinth of combinations in organic beings, and their ultimate return to binary compounds, are full of the most stupendous design. The final cause of the reduction of the organic being, when its own specific purposes are ended, is that of again supplying the means of growth to vegetables yet alive, that the elements may be again elaborated into ternary and quaternary compounds, to carry out the final purpose of the vegetable kingdom in supplying nutriment to animals (§ 303).—NOTE C p. 1113.

63. In the Essay to which I have referred in the last section, I have endeavored to deduce the principles of vitalism from the phenomena that attend the development of the incubated egg, as had been briefly set forth in my "Examination of Reviews." The considerations there made are peculiarly appropriate to the present work, and to the place at which I have now arrived. It was my object to consider,

1st. The constitutional nature of the ovum.

2d. To show by the philosophy of generation, and by the nature of the powers which are universally admitted to be alone concerned in developing the germ or ovum, and in forming the organs of the new being, that the *same* powers are, also, *alone* concerned in carrying on forever afterward the processes of life, and, of course, that no new powers, or principles, are introduced.

3d. To consider the manner in which the germ is impregnated, or its vital properties so stimulated into action as to result in the development of the germ, and in unfolding the various attributes of the new being.

4th. To show that we may find in the physiology of generation, or the principles through which the ovum is impregnated, the whole philosophy of organic life, or the principles through which the actions of life are forever carried on.

5th. To state the manner in which the natural peculiarities of each parent, whether as it respects the properties of life, or the physical conformation, are infused into the germ and combined in the full-grown offspring.

6th. To show that hereditary diseases are transmitted in the same way as those more natural peculiarities which belong to parents.

7th. To show, also, that the principles which are concerned in the transmission of hereditary diseases are the same as concur in the production of ordinary diseases.

8th. To deduce from the philosophy of generation the vital nature of hereditary diseases; or, in other words, to show that the morbid

impression is established upon the vital properties of the ovum, and of course, upon those of the new being; and that the hereditary vitiation does not consist in any transmitted impurity to the blood or other fluids of the offspring, as is now supposed by the humoralists.

If the foregoing propositions be true in relation to man, they will, of course, be equally so of animals, and of the whole vegetable kingdom (§ 169 *f*, 1051, 1052).

64, *a*. If it be universally conceded, as a matter of course, that not only the elementary constitution of the ovum, but its whole development, depends entirely upon a vital principle or vital properties, it will follow that the same principle or properties are forever afterward concerned in organic processes, and *alone* concerned.

Let us hear, in the first place, the most eminent in the school of vitalism, but who are inclined to lean upon chemistry after the full development of the ovum.

64, *b*. It is said, for example, by Tiedemann,

"That it is the *vital power*, which in the fecundated germinative liquid, brings the molecules of the organic combinations to the solid form, and calls the first lineaments of the vegetable and animal embryo into existence. All the parts and tissues that are formed in it, according to a definite order of succession, are products of the power of formation, and on this they depend in all that relates to their first appearance, their development, aggregation, configuration, and arrangement. The phenomena exhibited in the act of formation of an embryo, are placed *far above* all the mechanical and chemical acts we observe in bodies not endowed with life."—TIEDEMANN, *Comparative Physiology*.

64, *c*. By the illustrious Müller, it is said,

"The *creative* force exists already in the germ, and *creates* in it the *essential parts* of the future animal. The germ is *potentially* the *whole* animal. During the development of the germ, the *essential parts* which constitute the *actual* whole are produced." "The entire *vital principle* of the egg resides in the germinal disk alone; and since the external influences which act on the germs of the most different organic beings are the same, we must regard the simple germinal disk as the *potential whole* of the future animal, endowed with the *essential* and *specific force* or principle of the *future* being, and capable of increasing the very small amount of this *specific force* and *matter* which it already possesses, by the assimilation of new matter." And again he says, "This *force* exists *before* the harmonizing parts, which are, in fact, FORMED BY IT during the development of the embryo." "The *vital force* inherent in organic beings *itself generates* the essential organs which constitute the whole being." "The formative or organizing principle is a CREATIVE POWER, modifying matter blindly and unconsciously;" yet with such wonderful precision that Müller also says, that "this RATIONAL CREATIVE FORCE is exerted in every animal strictly in accordance with what the nature of each requires." "The vital principle," he says, "is in a quiescent state in the egg before incubation."—MÜLLER, *Elements of Physiology*.

64, *d*. Passing from the chemico-physiological school to that of pure chemistry, we shall find the same admissions as to the exclusive agency of a vital principle in the formation and development of the

seed and ovum. The extraordinary contradictions, which will astonish the reader, necessarily abound in all authors who are employed in identifying two subjects that have no relation to each other.

64, *c.* Take Liebig, as a first example; and take, in the first place, his chemical doctrine of life.

"In the animal body," he says, "we recognize, as the ultimate cause of all force, only one cause, *the chemical action* which the elements of the food and the oxygen of the air mutually exercise on each other. The only known ultimate cause of vital force, either in animals or in plants, is a CHEMICAL PROCESS. If this be prevented, the phenomena of life do not manifest themselves. If the chemical action be impeded, the vital phenomena must take new forms."

And yet only a few sections before, and in the very first sentence of Liebig's work on "Animal Chemistry applied to Physiology and Pathology," we read,

"In the animal ovum, as well as in the seed of a plant, we recognize A CERTAIN REMARKABLE FORCE, the SOURCE of growth or increase in the mass, and of reproduction, or of supply of the matter consumed; *a force in a state of rest.** By the action of external influences, by impregnation, by the presence of air and moisture, the condition of static equilibrium of this force is disturbed. Entering into a state of motion or activity, it exhibits *itself in the production of a series* of forms, &c. This force is called the *vital force*, *vis vitæ*, or *vitality*." —LIEBIG'S *Animal Chemistry.*

Turning back to the same author's work on "Organic Chemistry applied to Physiology," we meet not only with a similar contradiction of his grand doctrine of the entire dependence of life upon chemical processes (and as we had before seen in respect to digestion, section 60), but with that which is particularly apposite to my present inquiry.

"Our notion of life," says Liebig, "involves something more than mere reproduction, namely, the idea of an ACTIVE POWER *exercised by virtue of a definite form*, and production and generation in a definite form (§ 59). The production of organs, the co-operation of a system of organs, and their power not only to produce their component parts from the food presented to them, but to *generate themselves* in their original form and with their properties, are characters belonging *exclusively to organic life*, and constitute a form of reproduction INDEPENDENT OF CHEMICAL POWERS. The *chemical forces* ARE SUBJECT to the INVISIBLE CAUSE BY WHICH THIS FORM IS PRODUCED. This VITAL PRINCIPLE is only known to us through the peculiar form of its instruments; that is, through the organs in which it resides. Its LAWS must be investigated just as we investigate THOSE OF THE OTHER POWERS WHICH EFFECT MOTION AND CHANGES IN MATTER."—LIEBIG'S *Organic Chemistry*, &c., p. 355.

64, *f.* Roget, of high authority, maintains that,

"However the laws which regulate the vital phenomena may appear, on a superficial view, to differ from those by which the physical changes taking place in inorganic matter are governed, still there is really no essential difference between them." "It may, in like manner, be contended, that the affinities which hold together the elements of living bodies, and which govern the elaboration of organic products, ARE THE SAME with those which preside over inorganized compounds."

* See my *Examination of Reviews* p. 7–28.

"Hence it becomes every day more and more probable that the forces immediately concerned in the production of chemical changes in the body ARE THE SAME as those which are in constant operation in the inorganic world; and that we are not warranted in the assertion that the operations of vital chemistry are directed by distinct laws, and are the results of new agencies."

"However *natural it may be* to conceive the existence of a single and presiding principle of *vitality*, we should recollect that this, in the present state of our knowledge, is only A FICTION OF THE MIND, NOT WARRANTED BY THE PHENOMENA THEMSELVES."—ROGET'S *Outlines of Physiology.*

Let us now hear this able writer on the subject of fœtal development.

"A portion of the VITAL POWER of the parent," he says, "is for this purpose employed to give origin and birth to the offspring. The utmost solicitude has been shown in every part of living nature to secure the perpetuity of the race, by the establishment of LAWS, of which the operation *is certain in all contingent circumstances.*"

Roget ultimately describes, in his usual felicitous manner, the development of the ovum; and here we have nothing from our author but the agency of the *vital powers.*

"The foundations of the edifice," he says, "are laid in the homogeneous jelly *by the* EFFORTS OF THE VITAL POWERS." "At first, all the ENERGIES OF VITALITY are directed to the raising of the fabric, and to the extension of those organs, which are of greatest immediate utility; but still having a prospective view to farther and more important ends,"—and so on throughout the chapter; the whole work of developing and fashioning the fœtal organs being assigned, exclusively, to "the efforts of the vital powers," and to the "energies of vitality."—ROGET'S *Animal and Vegetable Physiology, Bridgewater Treatise.*

64, *g. Finally,* let us hear, also, Dr. Carpenter, who advocates the chemical doctrines of life so far as to lay down the following principle no less than twice within six pages, and in nearly the same words. Thus:

"Reason," he says, "has been already given for the belief that the affinities which hold together the elementary particles of *organized* structures are not different from those concerned in the *inorganic* world; and it has been shown that the tendency to DECOMPOSITION AFTER DEATH BEARS A VERY CLOSE relation with THE ACTIVITY OF THE CHANGES WHICH TAKE PLACE IN THE PART DURING LIFE."—CARPENTER'S *Principles of General and Comparative Physiology,* p. 140; also, p. 146.

Now the authority of such a writer, and a prominent leader in the purely chemical school of physiology, must be allowed to be important when any unavoidable concession is made to vitalism. Let us then hear him in the matter of the ovum:

"Organization, and *vital properties,*" he says, "are simultaneously communicated to the germ by the structures of its parent. THOSE VITAL PROPERTIES CONFER upon it THE MEANS of itself assimilating, and THEREBY ORGANIZING AND ENDOWING WITH VITALITY *the materials supplied by the inorganic world.*"—CARPENTER'S *Principles,* &c., p. 138.

And again, this mere chemist, in his general views of the philosophy of life, observes, that

"The AGENCY of VITALITY, as Dr. Prout justly remarks, does not change the properties of the elements, but simply COMBINES THEM [the elements] IN MODES WHICH WE CANNOT IMITATE."—CARPENTER'S *Principles*, &c., p. 146.

64, *h*. Dr. Prichard is strictly of Dr. Carpenter's school (see my "Examination," &c., p. 37), between whom there is a point of agreement which is worth noticing in its connection with the subject now before us, and to which I have referred in a former work, in its relation to Dr. Carpenter. Both of these writers see so much of peculiar design in organic nature, and find it so impossible to interpret the phenomena of organic beings upon the chemical and physical principles which they have so strenuously set forth, and in their aversion to any other principles, and to the obvious rule of analogy as to second causes, that, in the end, they assign the functions and phenomena of life to the *immediate* action of the Deity.

"The theory of a vital principle," says Dr. Prichard, "has been applied in a different manner, to account for the phenomena displayed at the beginning of life in animals and vegetables, and to get rid of the mystery which attends the gradual evolution of organic structure from ova and germs. Here the vital principle *is no longer considered a chemical agent*, but assumes the character of a plastic and formative power," &c.

Now Dr. Prichard "cuts the knot" and "gets rid of the mystery" after the following manner:

"We may," he says, "if we choose to do so, term the cause which governs the organization and *vital* existence a plastic principle; but it is a principle ENDOWED WITH INTELLIGENCE AND DESIGN [!] It is, in fact, nothing more than the Energy of the Deity." "The development of forms, according to their generic, specific, and individual diversities, not less in the vegetable than in the animal world, can only be accounted for by ascribing it to the universal energy and wisdom of the Creator."—PRICHARD'S *Review of the Doctrine of a Vital Principle*. See, also, PAINE'S *Commentaries*, vol. i., p. 10, 25; and his *Examination of Reviews*, p. 37, 41, 43, 44.

This is a far greater admission than the vitalist can desire; since, if the development and growth of the germ depend immediately upon Almighty Power, so must all the analogous processes of the living being at all stages of its existence, and science would be merged in the direct manifestations of that Power. But, while this doctrine is utterly exclusive of all the assumed chemical agencies at all periods of life, and overlooks the analogy between the development of the germ and the subsequent processes, there can be no hesitation as to the disposition which should be made of it, without any reference to its prevaricating nature (§ 175 *d*, 699 *c*, 740).

65. Having now before us a plain statement of our necessary premises as they respect the exclusive agency of the "vital principle," or "organic force," or "creative power," or "vital properties," or "vital powers," or "vitality" (whichever term may be preferred), in carrying out the full development of the embryo, it may be interesting to know the details of that development and growth, which is thus allowed, on all hands, to be conducted by powers utterly distinct from the chemical and physical, and in which these have no agency.

"The development of the separate parts," says Müller, "out of

the simple mass, is observable in the incubated egg. All the parts of the egg, except the germinal membrane, are destined for the nutrition of the germ. The simple germinal disk is the potential whole of the future animal, endowed with the essential and specific force, or principle of the future being, and this germ expands to form the germinal membrane, which grows so as to surround the yolk; and by *transformation* of this germ, the organs of the future animal are produced. The rudiments merely of the nervous and vascular systems, and of the intestinal canal, are first formed; and from these rudiments the *details* of the organization are afterward more fully developed; so that the *first* trace of the central parts of the nervous system must be regarded neither as brain nor as spinal marrow, but as still the *potential* whole of the central parts of the nervous system. In the same manner, the different parts of the heart are seen to be developed from a uniform tube; and the first trace of the intestinal tube is *more* than the mere intestinal tube; it is the *potential* whole, —the representative of the entire digestive apparatus; for, as Baer first discovered, liver, salivary glands, and pancreas, are, in the farther progress of the vegetative process, really developed from that which appears to be merely the rudiment of the intestinal canal. It can be no longer doubted that the germ is *not* the miniature of the future being, with all its organs, as Bonnet and Haller believed, but is merely *potentially* this being, with the SPECIFIC VITAL FORCE of which it is endowed, and which it *becomes actually* by development, and by the production of the organs essential to the active state of the *actual* being. A high magnifying power is not necessary to distinguish the first rudiments of the separate organs, which, from their first appearance, are distinct and very large, but simple. So that the later complicated state of a particular organ can be seen to arise by transformation from its simple rudiment. These remarks are now no longer mere opinions, but facts; and nothing is more distinct than the development of glands from the intestinal tube, and of the intestinal tube itself from a portion of the germinal membrane." —MÜLLER, *ibid*—(§ 1051, 1052).

Such, then, is the history of the development of the germ in birds, and in all the higher animals; and the whole work is ascribed by physiologists of every denomination exclusively to principles unknown in the inorganic world, and wholly distinct from any of a chemical nature. They are called, indiscriminately, *vital properties*, *vital powers*, *vital principle*, *organic force*, *creative force*, &c., to distinguish the principle, or properties, from every thing that has any known existence in inorganic substances, or as the source of any inorganic results. But, physiologists of the chemical school stop here, and ascribe all organic compounds after the being is fully formed to chemical agencies. It is remarkable, however, that it has not occurred to these philosophers, that precisely the same elementary combinations, the same formation into tissues, and the same secretions, take place at all stages of the rudimentary development as at all future periods of life, and that the rudimentary development consists in these formations of simple compounds and their union into tissues; and if the early or rudimentary growth of the being, all its secreted products, all its elementary combinations, be determined by the vital properties, so are the *same* results determined by the same properties

or powers forever afterward. To call in the agency of chemical or physical forces, to accomplish *precisely* the same results at any future stage of the organic being as are admitted to be performed in the development of the "essential parts" of that being by the "vital principle" or "vital properties" alone, is a violation not only of the plainest rule in philosophy, but of the clearest facts (§ 41, 42, 55–58).

66. We have thus before us a peculiar order of powers by which the organic being is developed, fashioned, and forever exclusively governed. It is these powers about which physiology, pathology, and therapeutics, are essentially concerned. We may, therefore, seek in the composition of organic beings, and in the laws of their development, *for the great rudimentary principles of medicine.* The vital principle has also the extraordinary task of laying out, in the ovum, the whole organization of the future being; so that its subsequent labor must be comparatively simple, and it is then, least of all, that it can require any help from the forces of the inorganic kingdom, or that it would permit a violation of the great principle in nature of avoiding an unnecessary multiplication of causes.

67. It may be farther shown by the incipient development of the ovum, that the vital powers, or properties, are more concerned in the growth, nutrition, and all the subsequent physical results, throughout the whole existence of the being, than is generally supposed by even the exclusive vitalists. The usual supposition is that the vessels or instruments of action, which are moved by the vital powers, perform the work of decomposing the blood and other parts, and recombining them again in other proportions and forms, according to the particular organization of parts, and the modification of their vital states. It has been the doctrine of most physiologists till a recent day, that the ovum, in its germinating part, is a mere organic fluid, destitute of vessels, and all other parts of the future apparatus. Later researches, however, have disclosed the existence of a rudimentary cell; and it is said by Müller (1835) that "in the incubated egg the sole material for the first formation of blood is the substance of the germ or germinal membrane, which itself grows by assimilation of the fluid of the egg, or the yelk. It may be distinctly observed that the blood is generated in the germinal membrane before the vessels are formed;"* from which it appears that the first "assimilation of new matter" must take place without the agency of vessels, or of any parts which are subsequently formed; and, therefore, the same powers which enabled the cell to generate vessels, nerves, &c., continue to make the same conversion out of blood; and as all this was originally done without the aid of vessels, so must the same powers be forever operative with their subsidiary agency only.† As the ovum possesses the potential whole, it is equivalent to the mature structure.

We see, therefore, that Müller, reasoning upon other grounds, may not have been altogether hypothetical in his inference that the "vital principle exerts its influence even beyond the surface of an organ, as shown by its effects on the chyle, in maintaining the fluidity of the blood," &c.

By the same rule, it may be at once shown that the only ingenious chemical hypothesis ever invented to interpret organic results,—the *catalytic*,—is purely an assumption; since this hypothesis is predica-

* Kölliker states that "the membrane of animal cells, the largest of which are yelk-cells, exhibit no structure of any kind."—*Microscopical Anatomy*, Wurzburg, 1852.

† So far as this the author had inculcated more than twenty years ago what is now known as the *cell-theory*—1870.

ted of the blood-vessels. But, if there be no vessels in the germ, the first vessels must, of course, be produced without the supposed chemical influence of vessels, and, by my showing, therefore, as to the subsequent formation of vessels and other parts, the supposed agency of the catalytic forces is a mere assumption (§ 41, 42, 1051; also, *Medical and Physiological Commentaries*, vol. i., p. 74–76).

On this subject, too, chemistry must abide by admissions which are made in the very face of consistency; so imperative is fact, and so imbecile is hypothesis. Thus, it is said by the distinguished chemico-physiologist, Dr. Prout, that

"The most determined sceptic cannot assert that there is any necessary relation, or, indeed, ANY RELATION WHATEVER, between the mechanical arrangements and the chemical properties to which they administer. There is NO REASON why the chemical changes of organization should result from the mechanical arrangements by which they are accomplished [!]; neither is there the SLIGHTEST REASON why *the mechanical arrangements*, in the formation of organized beings, *should lead to the chemical changes of which they are the instruments*" *!*—DR. PROUT'S *Bridgewater Treatise.*—Such is the proof which chemistry offers.

68. The question then arises as to what is the particular office of those vessels where the elementary combinations and decompositions take place? Simply this: to convey, and eliminate through the agencies of the vital properties, those parts from the blood out of which the vital properties effect the new elementary combinations, whether solid or fluid,—to aid in arranging the new molecules, and to carry forward those fluid products which may be destined for other ends.

69. But, have not the nerves an indispensable agency in effecting the elementary combinations and decompositions? Certainly not, as I shall endeavor to show. But the sympathetic nerve exerts an influence upon all organic functions, and impresses a special condition upon all organic compounds, and this physiological law is extensively involved in pathology and therapeutics (§ 226, 232, 233, 399, 446 *a*, 461, 461½, 488½, 489, 512, 639, 746 *c*).

70. But, all the vessels, and all the solid parts of the organism, have their various specific offices. Here, in every part, reside the vital properties, which had been fully developed in the ovum, and here are they modified according to the exact nature of the organization and the peculiar final causes of "the properties of the vital principle" in each part. Hence they manifest peculiarities in parts that are apparently alike. The modifications vary, for instance, in the serous membranes, and more remarkably in the mucous, as known by the influence of foreign agents, their phenomena, their products, &c. The vital properties differ in different parts of one and the same continuous tissue, as in the mucous tissue of the nose, lungs, stomach, &c. Hence one of the important objects of studying the structure of organs, and the nature of their tissues; for, as the vital properties are naturally modified in different parts, so will their alterations in the same disease be different in different tissues of one organ, and, for the same reason, even of different parts of one continuous tissue.

These natural modifications of the vital properties in different parts have, at least, three great final causes. The first is what I have already stated, namely, to separate from the blood, through the agency of the capillary vessels, that exact part which is to be decompounded

at any given point; the second is, by these modifications, to enable "the properties of the vital principle" to decompound and recombine the elements according to the exact nature of the combinations which belong to the part; and the third, to qualify the properties, through the medium of the capillary vessels, to shape and unite the new molecules to the old. It is easy to apply this principle, under its different aspects, to all other vessels, as the veins, the secretory and excretory vessels of the glands, and the absorbents.

71. Now, at the first start of the development of the germ, "the properties of the vital principle" (as they are well designated by Müller) are but very imperfectly, if at all, aided by any of the foregoing physical means, though they come into operation at the moment they are successively produced. "The properties of the vital principle," therefore, must exist in that potential cell in a modification, and with a formative energy which they do not possess in any of the new developments; and herein it will have been seen that the very chemist has come to this conclusion (§ 64 *f*, 190 *b*).

72. The process of generation presents a varied and most impressive illustration of the peculiarities of the vital properties, and of the manner in which they are liable to be impressed and permanently modified in their nature. It results in the production of organic beings similar to those which exercise the generative faculty. This faculty is therefore manifested with as many specific modifications as there are different species of organic beings. If we allow to the globe one million of distinct species of animals, the specific modifications of the germinal product will be as numerous, and these are more or less influenced by the semen of the male. The seminal or productive principle of the male exerts its special influences upon the living properties of the germ, and according to the special constitution of the ovum directs their operation in such a manner that none but beings of the same kind with the parents, where both are of the same species, are produced. That the various modifications which distinguish each species are determined by both parents is fully demonstrated in hybrid animals, and is sufficiently obvious in the transmission of the peculiarities of the male or female, where the individuals are of the same species. And, notwithstanding our supposed million of distinct species of animals, and the specific variations in all the parts of each species (§ 41), this almost endless variety is made up by successive depositions of elementary compounds out of mainly four simple substances (§ 37, 42, 46), three of which are gaseous, united in modes unknown to chemistry (38–40, 48), and which chemistry cannot detect, and forever uniting in different modes and proportions according to the exact nature of every part (§ 43, 44). The act of generation establishes the essential modifications which are to be continued, without variation, throughout the life of the new being; and this new individual, becoming in its turn the agent of procreation, perpetuates all the specific modifications which appertain to itself and to its ancestors. The intermingling of species, which results in hybrid animals, proceeds upon the same plan. It must therefore necessarily be, that the vital properties of the ovum are so impressed by the exciting influences of the semen that those peculiar elementary combinations and aggregations are started which ultimately make up the hybrid. "These vital properties," says Dr. Carpenter, "confer upon it *the means* of itself

assimilating, and thereby *organizing*, and *endowing with vitality*, the materials of the *inorganic* world;" leaving it, also, clear to all minds that the action of the semen must be exerted directly upon the vital properties of the ovum (§ 189, 1051).

That this important question as to the direct action of the semen upon the vital properties of the ovum, and its capability of establishing certain modifications of these properties, and that the humoral interpretation of transmitted peculiarities is an unfounded assumption, may be definitively settled, I will also add,

"The well-known fact, that when the Earl of Morton's Arabian mare was covered by the quagga, not only did the mule so begotten partake of the character of the sire, but when the mare was subsequently submitted to an Arabian stallion, by whom she had three foals at different times, the first two continued to exhibit some of the distinctive peculiarities of the quagga conjoined with the characters of the Arabian breed."—MONTGOMERY, *on the Signs and Symptoms of Pregnancy*, p. 17. This should overthrow the whole fabric of humoralism.*

The author of the foregoing statement supposes that the semen "may influence several ova, and so continue to manifest its effect in the offspring of subsequent conceptions when impregnation has been effected" by males of another species. The reader will also not fail to remark that the history of this case is in direct conflict with the late attempts to revive the old doctrine of referring the germ to the male parent (§ 67, 1051, 1052, 1078).

73, *a*. The semen, then, is a vital stimulus, and so far on a par with the ordinary stimuli of life. These may be natural, like air, food, heat, &c.; or they may be morbific, like malaria, poisons, &c.; or curative, like medicines. In all the cases, their action is upon the vital properties; and it is in consequence of these influences that the ovum is developed, that life is maintained, health preserved or impaired, or disease removed. The ova of oviparous animals show the analogy in respect to stimuli, and the principles involved, more impressively than those of viviparous; since by an admirable design, in respect to the former, the impression of the semen has a limited operation, when the vital properties of the ovum return to their quiescent state, but may be again roused into action by the simple stimulus of heat. (See *Med. and Phys. Comm.*, vol. i., p. 21, &c.)

73, *b*. The action of the semen upon the properties of the vital principle of the germ is a type of all the influences that are produced upon the same vital properties during the life of the animal, and from which all its organic actions, and all their results, arise. And so of the germination and growth of plants; which, by-the-way, evinces the common nature of the principle of life, and of organic actions, in the two departments of the animated kingdom (§ 188½, *d*). It is the whole essential philosophy of physiology. It is the alterations produced in the vital properties which constitutes the philosophy of disease, and in which, indeed, all disease virtually consists. It is the art of finding out the remote causes, and the nature of the alterations they produce, and of adapting to the altered condition of the properties of life such agents as shall establish new impressions upon them, and thus enable them to return to their natural state, which forms the basis of therapeutics in its connection with pathology.

74. *a*. Here I shall digress for a moment, to consider certain anal-

* The same is stated of Sir G. Ousley's mare and a zebra, and of a mare and an ass, and the subsequent foals by stallions.

ogies in the development of special organs, through the influence of specific stimuli, with that general evolution of the organic fabric which is started by the action of the seminal principle upon the germ. These analogies are to be found in the organs of animal life. The senses, for example, sometimes manifestly require for their full development the prolonged operation of the stimuli which are natural to each. This is habitually observed in the young of some animals, and is seen conspicuously in the subterranean fish of Kentucky. In this last instance organic life is perfectly developed; but, owing to the exclusion of the natural stimulus of the eye from the very outset of life, that organ remains in its rudimentary state.

A fortiori, therefore, the reputedly first inhabitants of this globe, such as the trilobite, attest the existence of the same light at their creation as is enjoyed at the present day; geologists to the contrary notwithstanding (§ 1079, *b*).

Superficial observers of nature, either through inattention to the moral consequences, or through infidelity, are apt to believe that physical agents are the real creative forces of organic beings, from observing that particular parts are clearly dependent for their development upon the action of certain specific stimuli. But, in all these cases, the rudiment is there, and has been perpetuated ever since the original species came from the Hand of Creative Power. That Power is entitled to all the praise, as the Author of the rudiment, of its endowment with peculiarly modified properties of life, of the existence of the physical agents, and of the mutual adaptation of these modified properties of the rudiment and the virtues of the physical causes, so that the operation of the latter upon the former shall result, for example, in vision, and, under certain circumstances, as when the ovum is developed and matured out of the body, the physical agent, in the example supposed, shall be necessary to the development of the rudimentary organ of sight (§ 350$\frac{3}{4}$, *h*–350$\frac{3}{4}$, *l*). The principle is much the same as that which applies to the necessity of external heat and light to the development and growth of plants. The specific stimulus of light by which the vital properties and actions of the leaf are enabled to decompound carbonic acid, and to assimilate the carbon, is manifestly a parallel example with my supposed influence of light in developing an animal organ in which the nervous system is extensively incorporated for the final cause of the whole organ; although it be certainly true that, in the case of the eye as of the leaf, the essential influences of light are exerted upon the organic properties of either part, and that the nervous system, in the former case, is only a medium of transmitted influences to the organic properties (§ 188, 188$\frac{1}{2}$, 189, 202, 203, 222, 223, 226, 227, 514 *k*, 1072 *a*, *note*).

It would be an interesting inquiry to ascertain whether, by a total exclusion of light from the ovum of fish, after fecundation, the peculiarity of the Kentucky wonder may not be established in the first generation; and whether, also, an exclusion of light for a series of years would not be followed by a failure of the balance of absorption and nutrition in the eyes, and consequently a wasting of those organs. The general law of absorption operates universally, without the aid of any specific stimulus; while it is clearly otherwise in respect to nutrition, and especially in regard to certain organs. The voluntary muscles become emaciated from want of the stimulus of exercise, &c

We see, therefore, how it happens that fishes with and without eyes may exist together in subterranean caverns as extensive as that of Kentucky; the latter inhabiting the dark regions, while the former exist in springs near the crevices of the cave (§ 136, 137, 548 *a*, 649 *d*, 733 *b*).

74, *b*. Such, then, is my philosophy of this subject, and such the full extent of the ground upon which infidelity would plant its standard. Nor will I dismiss this subject without referring, now and hereafter, to the calm indifference with which this infidelity is regarded even by the religious world, by adducing not a few of the present popular treatises on theoretical geology (§ $350\frac{3}{4}$, *g–k*, 1085).

75. Let us now see if the beginning of individual existence does not supply a key to the whole philosophy of disease, as it does to that of physiology. We have seen that all the actions, and all the results of life, are merely effects which arise from the operation of the vital properties through their organic instruments (§ 65–67, 133, &c., 188, &c.). These properties must be constantly excited into action by foreign agents, as by food, blood, &c., or the properties will become extinct, and, of course, the effects will cease (§ $188\frac{1}{2}$, *b*). Now, the actions in disease are nothing more than the altered actions of health, and the same rule applies to all the morbid products. It follows, therefore, that the properties of life, upon which these altered conditions depend, are modified or altered in a corresponding manner. As a consequence of this, it also results that the vital properties have been varied from their natural state by agents or causes capable of producing the change. These agents make their impressions in the same way as the natural stimuli of life, only the morbific agents at the same time affect the nature of the vital properties, and bring them into a new condition. This new condition constitutes disease.

76. The type of all this may be found in the impregnated ovum. The properties which animate the germ *before* conception are determined entirely by the vital constitution of the female parent. But we have seen that the new being may partake of the physical characters of the male as well as of the female, and it happens not unfrequently that the characteristics of the male are predominant. Hence it follows that the semen so far establishes changes in the original constitution of the vital properties of the germ.

Since, therefore, all the fœtal developments, all their physical peculiarities, depend upon the precise modifications and actions of the vital properties (§ 70), and since these properties in the unimpregnated ovum are determined entirely by the female parent, their nature after impregnation must be more or less affected, and assimilated to the peculiar nature of the male parent in all the cases where the offspring manifest any of the male characteristics. This is entirely analogous, in principle, to the modifications which are produced in the properties of life by morbific causes; but with this difference in contingencies: in the case of the impregnated ovum the modifications are permanently established, and can never be altered, so far as the vital properties, in either parent, upon which the modifications depend, are fundamental in their nature. In the case of the morbific agent, or the cause of disease, the vital properties are diverted from the healthy state, and from *such* modified conditions they commonly possess the ability of escape, and of returning again to their natural standard (§

853, 858, 898). In the case of the impregnated ovum a modifying agent operates, whose properties are intended to confer on the new being a stable condition, however they may modify the exact constitution of the impregnated germ. This vital stimulus, the semen, therefore, in virtue of its specific properties, bestows upon the corresponding vital properties of the ovum the peculiarities which belong to itself; and these being natural, vital, and determinate, the transmitted peculiarities should be equally so. Or, where the male parent enjoys a perfectly natural constitution, the innate predispositions to disease depend upon special peculiarities in the vital state of the ovum, which may be as permanently established, through the modified constitution of the female parent, as any of the natural characteristics. In the case of disease, however, the morbific agents have none of the properties of life which are natural to the fecundating semen, and the modifications, therefore, which they may determine may be different, even if we suppose them to act, as in the case of the germ, upon the whole constitution. Whatever modifications, therefore, may arise from their action, they must consist of deviations from the standard of health. But, it does not necessarily follow that certain artificial modifications may not be as permanent as the natural ones; and it is from observation alone, that we learn that they are so, or nearly so; as in the case of artificial "temperaments," the effects of domestication upon animals, the changes which are wrought in the vegetable kingdom by cultivation and by change of climate (§ 535, &c.).

77. In the case, however, of the formation of temperaments by change of climate, and the more remarkable alterations produced in animals by domestication, and in plants by cultivation, &c., the results are brought about by the new and habitual influences to which the properties of life are exposed; and, in all these cases, a radical, and often permanent modification is established, approximating closely the modifications which are bestowed upon the germ by the fecundating semen. Now, it is also true, that what is denominated predisposition to disease is entirely analogous, in principle, to the permanent temperaments of which I have just spoken. Both are results of physical agents, modifying the properties of life; and this chain of analogies conducts us to those predispositions to disease which are impressed upon the germ by the fecundating semen, and by which I show that the philosophy of the operation of morfibic causes is variously, and even exactly exhibited in the impregnation of the germ (§ 63, 75, 535, 539, 559).

78. Take the scrofulous subject as supplying an example of hereditary predisposition to disease. If it exist in the female, her ova will partake of this peculiar modification of the vital properties, and it is in this way that her progeny inherits the scrofulous diathesis (§ 144–147). In this case, as in all transmitted predispositions to disease, the peculiarities induced in the parent have arisen, originally, from the operation of deleterious agents—imbuing the ovum with the modifications belonging to the female, or imparting to the semen the whole concentrated force of what may have been the slow work of numerous causes upon the male parent.

Here, then, we see illustrated in the very ovum, even before impregnation, the whole principle which concerns artificial temperaments, and those influences of morbific agents which establish predis-

positions to disease in the full-grown subject. It frequently happens, also, that this natural diathesis is so great, that it results in actual disease before the birth of the offspring, as manifested by tuberculous affections of the lungs, syphilis, and small-pox in newly-born infants.

79. But, to make the philosophy of this subject more obvious, let us consider the germ when it derives its scrofulous diathesis from the male parent. Before impregnation its vital condition is perfectly natural. The semen of the male parent establishes upon it the modification which constitutes the predisposition to scrofula, just as malaria determine those modifications which result in fever, &c. And here we may readily detect a perfect analogy between the alterative influences of the semen and of remedial agents, and come to understand how it is that the latter produce their effects (§ 904, *d*). We have only to observe those instances where some of the offspring inherit the scrofulous diathesis of the female parent, while others are as entirely exempt as the male parent; the natural condition of the semen having altered the vital constitution of the ovum in the latter case, and impressed a disposition to a development of the new being in its perfect state.

80. The subject may be pursued under a variety of aspects, and with various illustrations, whether physiologically or pathologically. Other exemplifications will occur under the subjects of *vital habit* and the *temperaments*. The same principle is concerned throughout, whether in respect to the physiological conditions impressed upon the ovum by the seminal fluid, or as those conditions are modified in hereditary scrofula, gout, &c., or whether it concern the temperaments and other permanent changes that are induced by climate, domestication, &c., or as malaria may establish their peculiar modifications of the properties of life. Nor can such conclusions be unexpected to those who duly consider the simplicity of nature in her elementary principles and laws (§ 561).

81. Could the doctrine entertained by Walker, Elliotson, and others, that the imagination of the parents influences the physical organization of the offspring, be shown, the philosophy which I have set forth, though not rendered more clear, would be yet fortified. But, this is at best but speculation. I could, however, turn to the mysterious production of the soul. This remarkable principle is doubtless developed at the very outset of fœtal life, as evinced by its often combining the intellectual peculiarities of both parents, or, again, of manifesting chiefly those of the male. But here we have no other fact to guide us, and all beyond has been involved in an impenetrable mystery by the great Creator. Here it is a pride and a help of philosophy to rest on faith alone (§ 433).

82. For an examination of vital phenomena, and relative facts, in proof of the existence of properties peculiar to organic beings, and of the abstraction of such beings from the laws of the inorganic world, see Essay on the "Vital Powers," in *Medical and Physiological Commentaries*, vol. i.

SECOND DIVISION OF PHYSIOLOGY.

STRUCTURE.

83, *a*. THERE are certain details in respect to the structure of organs which must be stated, now and hereafter, to enable us to comprehend the laws which govern the healthy and morbid states of man

Perhaps few things can impress us more forcibly with the importance of a correct analysis not only of the physical organization of all parts of the body, but more especially of the vital characteristics of each part, than the continued propagation from high sources of doctrines like the following; while they equally prove my position as to the appropriate sources of knowledge (§ $5\frac{1}{4}$–$5\frac{1}{2}$, &c.), and the tendencies of the microscope.*

83, *b*. The errors in doctrine to which I have referred are revealed sufficiently in the following extract from an article by the distinguished Mr. Paget, contained in the 27th volume of the Transactions of the Royal Medical and Chirurgical Society, London, 1844. The article is entitled "An Account of the Examination of a Cyst containing Seminal Fluid;" in the course of which Mr. Paget observes,

"If, with the aid of these observations, we endeavor to find an explanation of the occurrence of spermatozoa in the fluid of cysts connected with the testicle, we may suppose either that the fluid part of the semen has permeated from the seminal tubes into the cysts, and been farther organized in them; or, that *the cyst itself* secretes a fluid in which the organic structures of the semen may be developed." "The most probable explanation of these cases, therefore, seems to be, that certain cysts, seated near the organ which naturally secretes the materials for semen, may possess a power of secreting a similar fluid"† (§ 251).

I cannot doubt that before I shall have parted with the reader in what I shall have said of the peculiarities of structure, and the more remarkable modifications of vital properties and functions, there will be a disposition to concede the importance of the subject, and that this importance is rendered more manifest by the prevalence of opinions analogous to those in the foregoing extract.

83, *c*. As I have already intimated, however (§ 2, *c*), anatomical science can lead, originally, to no conceptions of the properties and functions of life, and therefore to none of their modifications in dis ease. The most that we can infer, abstractedly, from a knowledge of structure, are certain general results that are denoted by the constitution of organs, or assemblages of organs, upon the known principles

* See *Medical and Physiological Commentaries*, vol. i., p. 699–712. Also, my *Examination of Reviews*, p. 6, 89, 90.

† The Medico-Chirurgical Review for January, 1845, quotes this paragraph, and observes of it, that "Mr. Paget's explanation of the vicarious appearance of the spermatozoa, which has of late so much puzzled the members of the society, has the merit of being *ingenious* and *original*."—I cannot acquiesce in this decision. The doctrine is old, though recently, for the first time, enforced by the deceptive report of the microscope. It is thus noticed in the *Medical and Physiological Commentaries*: "True, we know that the ancient belief is even maintained at this day, by Sir A. Cooper, and others, that the testis is of no special use, but that the semen is the product of those simple reservoirs, the vesiculæ seminales. But, what does this show?" &c. See, also, my comments on this subject, in vol. i., p. 588, and on the supposed vicarious secretion of milk, urine, &c., p. 601–603.

of Design. The construction of the eye, for example, evinces some great final cause relative to light; that of the urinary apparatus, that a fluid is produced by the kidneys, and conveyed to a receptacle where it accumulates, and is finally evacuated through the urethra; and so of many other parts. We thus infer, also, the uses of each part, individually, from their relations to each other as a system of Design. In other cases the function of a part may be inferred from the known uses of other parts to which it is related; as the valves of the veins, for example, were supposed by Harvey to be designed for giving the blood a direction toward the right cavities of the heart; and this induction from anatomical Design conducted him to a full exposition of the circulation. But, in respect to the great processes of life, no conclusions can be originally drawn but through their phenomena, nor does structure denote even the principle of vision (§ 251).

Having, however, acquired a knowledge of structure in a particular species of animal, as man, for example, and learned the uses of each particular part by a study of its phenomena, so perfect is the system of Design throughout organic nature, and so harmonious are the analogies of function among organs that bear certain resemblances of structure, or of relations to each other, in all species of animals, although the differences in respect to structure, particularly, may be very great (§ 107, 409, *e*), yet illustrated by greater analogies of relation, we may generally infer, by this analogical process (§ 5¼), the absolute uses of every part in any species of animal that may be, for the first time, subjected to the knife of the anatomist. And this process of induction may be carried to a great extent from an established standard of comparison in the animal to the vegetable kingdom. But the principle is equally comprehensive in respect to plants, when, as with animals, a complex being is marked out, as a standard, in all its structures and functions.

The same is also true, though in a far more limited extent, of the modifications of structure, and the corresponding modifications of function, at the different eras of life (§ 153–162). And when we come to the variations of function in morbid states, though unattended by any appreciable alteration of structure, and consider how various must be the treatment according to the nature of the affected tissue, we are deeply impressed with the indispensable importance, to the physician, of an accurate knowledge of all that is relative to the sensible organization of the material part of organic life (§ 2, *c*). Though the structure, itself, reflect no light upon pathology, excepting through its morbid alterations, an observation of its morbid phenomena leads us to a knowledge of the parts diseased, and this knowledge is important to a just interpretation of the phenomena, and to a right method of treatment (§ 131).

83½. We have now seen that the composition of organic beings is formed by properties peculiar to organic structure, and that what is thus at the foundation presides over all, and is the cause of all that is superinduced upon that composition. The structure of organic beings, which is comprehended under our second division of physiology, is therefore dependent on the same creative cause.

84. The greatest physical characteristic of organized structure is supposed to be its arrangement into cells. Here all analogy with inorganic substances disappears entirely. The chemico-physiologists

imagine that the contradistinction between organic and inorganic beings commences at this step in the ascending series of organic results (§ 42). But we have seen sufficiently that all that relates to the *composition* of plants and animals is equally significant of a radical distinction between the simplest organic compound and those of an inorganic nature; the same powers being equally concerned in the formation of organic compounds as in their arrangement into tissues.

85. The general structure of organic beings is made up of tissues. A knowledge of the vital characteristics of the different compound tissues, of the same tissue in separate parts, of the different parts of one and the same continuous tissue as it may pass through different compound organs, of the whole as they may be combined into complex organs, of their vital relations to each other, and of all parts to each other, is indispensable to a knowledge of the laws in physiology, pathology, and therapeutics.

86. Bichat analyzed the tissues more ably than others, and arranged them as follows:

1. Cellular.
2. Nervous . . . . . { cerebro-spinal. / ganglionic.
3. Muscular . . . . . { involuntary. / voluntary.
4. Vascular . . . . . { arterial. / venous. / lymphatic.
5. Osseous.
6. Fibrous . . . . . { fibrous. / fibro-cartilaginous. / dermoid.
7. Erectile.
8. Mucous.
9. Serous.
10. Synovial.
11. Glandular.
12. Epidermous, or corneous.

87. Until the era of Bichat, the tissues were limited to three, as designated by Haller; namely, the cellular, muscular, and nervous. The cellular was supposed to form a large proportion of other tissues.

88. There was a great error, physiological and pathological, in the foregoing limitation (§ 87), since it took no note of the modifications of the vital properties, and of the particular functions of the tissues as arranged by Bichat.*

89. The several tissues are distinguished by differences of internal structure, as well as by modifications of their properties and functions. They are called *simple* organs, when considered in their functional character; and when two or more go to the formation of more complex parts, they are called *compound* organs. Certain compound organs, which concur together in some general function, are called an *apparatus;* as the urinary, the digestive, the circulatory, &c. As the whole exist in the universal body, they are called an *organism.* Each tissue, collectively, is also a *system;* as the mucous, serous, muscular, &c

* For practical purposes Bichat's analysis has not been improved, nor probably can be—1870.

91. The simple tissues rarely occur in a separate state, but are more or less connected together into complex organs.

92. The simple textures are, themselves, compound organs, so far as their organization is made up of various tissues. The union of tissues, therefore, in the simple textures, is quite different and far more intricate than when the simple textures form what is called, specifically, a compound organ.

93. The structure of the general body, and of its different parts, is radiated. The rays, or branches, of certain parts, as the vessels and nerves, are called ramifications. The rays increase in number and diminish in size, as they go off from the centres of radiation.

94. The trunks of vessels and nerves, and their ramifications, unite, respectively, in various ways with each other. This is *anastomosis*, and subserves very important uses. It promotes circulation in the vessels, and through the nerves it contributes especially to bind all the organs together in one harmonious action and common dependence. Through the last, also, the play of reflex nervous actions is promoted when the nervous power is developed in the central parts of the cerebro-spinal and ganglionic systems by morbific or remedial agents.

95. The animal organism is symmetrical as a whole, and in its various parts. This symmetry is conducive to uniform results, is important to the great processes of life, is always the same in the natural conformation, is indicative of great Design, and of peculiar properties and laws.

96. Bichat, "following the path marked out by nature herself," divided the animal organism into two great systems or classes; the distinction having been already indicated by Aristotle.

97. The first class relates to the individual being; the second to the species.

98. The first class is divided by Bichat into the organs and functions of *animal life*, and the organs and functions of *organic life*.

99. "The two classes have nothing in common, but the general connection that unites all the phenomena of living bodies; but a variety of distinctive attributes characterize them, which cannot be separated from them."—Bichat.

100. The organs of animal life are those whose functions connect us sensibly with external objects, are peculiar to animals, and distinguish them from vegetables.

101. The organs of organic life consist of such as perform functions that are common to animals and plants. "The only condition of enjoying this life is organization." It forms an indisputable boundary between organic and inorganic bodies.

102. Animals have two states of existence, sleeping and waking; but the former applies only to the division which embraces the functions of animal life. The animal powers are subject to fatigue, and require reposé; the organic are not, and are in perpetual operation.

103. The fœtus has only the organic functions in operation; but all its animal faculties and the soul exist in a passive state.* The latter are brought only gradually into exercise.

104. The great, immediate, office of the organs of organic life is to maintain a constant vital composition and vital decomposition of organic matter; or nutrition and waste.

* See *Medical and Physiological Commentaries*, vol. i., p. 13.

105. The organs of digestion, absorption, circulation, respiration, and secretion, compose organic life. Secretion comprehends nutrition, exhalation, calorification, and excretion; which four are often ranked as distinct functions.

106. "Animal life is composed of the organs of sense which receive impressions, of the brain which perceives them, reflects, and wills, of the voluntary muscles, and larynx, that execute this volition, and of the nerves which are the organs of transmission."—BICHAT.

107. The organs of organic life are quite analogous in the lowest animals and plants; but each has peculiar characteristics. In animals a little higher in the scale, the common functions are performed by organs of greater complexity, and this complexity increases in the ratio of the development of animal life. Nevertheless, in most animals above the rudimentary there are the same subsidiary functions, whatever the difference in organization. There is in most, for example, the secretion of gastric juice, saliva, bile, &c., which subserve the common function of assimilation.

108. No organ of animal life, in a philosophical sense, is necessary to the individual. But, no part of the animal can exist without all parts of the organic system, or an equivalent; which is also true of the organic viscera. If the heart, for example, be wanting in the fœtus, the blood-vessels, as an equivalent, carry on the circulation.

109, *a*. The indispensable organs, of which no one can be abstracted without destroying the whole, are generally single in animals (§ 128). The same is true of plants, if we regard those organs which perform a common function in the light of a single organ. If the leaves fall spontaneously and abruptly in cold climates, no injury results to the plant, because it is passing into a torpid state.

109, *b*. Nevertheless, neither the action of the heart by which the blood is circulated, nor that of the lungs by which the blood is oxygenized, nor that of the brain by which the harmony of organs is maintained, nor that of the kidneys and skin by which redundancies are excreted, nor that of the liver by which bile is generated, nor that of any other compound organ, constitutes the real functions of life. They are only secondary or subordinate to others in which the absolute processes of life consist; and these are carried on by those extreme vessels which perform the immediate work of nutrition and vital decomposition. This is exemplified in the development of the ovum (§ 63–72), and throughout the vegetable kingdom. Indeed, life may be continued after removal of the brain merely by inflating the lungs; and could we substitute a machine for the heart, and the process of transfusion, both the heart and the lungs could be dispensed with for awhile.

These facts are important in showing the nature of the organic properties; how it is, and through what influences, the compound organs contribute, and are, each one, indispensable, to the life of animals; and that it is to the fundamental organization that we must look for all the absolute processes of life, and for the essential conditions of disease (§ 1041).

110. The parts by which life is carried on in the organic viscera are blended in the organs of animal life, and in those of the species.

111. The cerebro-spinal system is assigned both to animal and organic life. The sympathetic, like the cerebro-spinal, goes to the organic life of animals, and therefore pervades the organization in animal as in organic life (§ 110).

The cerebro-spinal nerves and the sympathetic interchange contributions, in all parts, by which important influences of the former are established in the organs of organic life (§ 452, &c., 500, 512, 514½–530, 889, 891½, *g*, *k*, 893, *a*, *c–e*, 902–905, 940–952).

112. Nevertheless, the cerebro-spinal system is especially designed for the uses of animal life; but an important final cause is answered in making it subservient to the common interests of the whole being (§ 455).

113. The sympathetic system is added especially to the organic life of animals on account of the complexity of the organs, and to unite them in harmonious action, through circles of sympathy, and thus render them, each in its place, conducive to a common end. The cerebro-spinal system contributes to this result (§ 111, 112); and each system, unitedly, or independently, exerts special influences on the specific actions of organs, though these actions are carried on essentially through properties inherent in the several tissues (§ 226–233, 485). The nervous influence thus also bestows upon animal compounds peculiarities that do not obtain in plants (§ 461, 489, 493 *cc*).

114. The most important common end (§ 113), as it respects the individual, relates to the functions of animal life. The organic system, then, in animals, though physiologically the most important, must be held subordinate to the uses of animal life. In plants, organic life is the whole being.

115. The foregoing union of organic life with all other parts (§ 110–114) establishes mutual relations between all parts of the organism, and brings the animal and sexual systems under the laws which appertain to the organic system (§ 455).

116. The same intimacy of parts confounds, in a degree, the distinction in the two lives (§ 115).

117. An important consequence of the foregoing vital union of organic with animal life (§ 110–114) is a general coincidence in the pathological as well as physiological condition of the whole. The diseases of each react mutually on each system of organs, each requires common methods of treatment, and remedial, as well as morbific, agents operate upon the universal body through any given organ (§ 455, 524, no. 1, 647), by exciting reflex nervous influences.

Nevertheless, diseases of the animal organs more readily derange the organic viscera than the latter the former; but, remedial agents operate far more powerfully in the opposite relation. The sympathies in the two lives, therefore, are not exactly reciprocal.

The foregoing apparent want of harmony in the physiological, pathological, and therapeutical relations of the two systems of life is reconciled by the consideration that nature has ordained, for the protection of the organs of animal life, that their wants shall be emphatically made known to those of the life on which they depend, and, on the other hand, their dependence on organic life has placed them under the special therapeutical control of that life; while the organic viscera being independent of the organs of animal life, therapeutical influences are but feebly propagated from the latter to the former. Such are the final causes in the great plan of Unity of Design.

118. The second class of organs and functions, which relate to the species, are divided into three orders: 1st, such as belong to the male; 2d, to the female; 3d, the functions relative to impregnation.

119. The several organs, and reproduction, belong both to plants

and animals. They are not necessary to the individual, though the whole organic system is necessary to their existence.

120. Although the organs of generation be not necessary to the individual, they exert many natural vital influences upon the animal functions. Their full development has also certain influences in organic life, which illustrate some important laws as to the vital properties. Their diseases may also give rise to great derangements of the organic functions. They fail earlier than the animal functions (§ 117, 578).

121. In the great sense of ultimate Design, all organic processes have for their final cause the development of the generative organs, and the production of germs; that similar beings may be maintained in one unvarying round of development and growth. Many beings die as soon as this end is attained, and return to the mineral kingdom to be again reorganized by plants, and again, and again, refitted for the nutriment of animals, and carry out, in both organic kingdoms, the final cause of their regeneration from the mineral.

122. It is necessary that the ovum of mammiferous animals should remain connected with the parent till the organs of organic life are developed. The law of dismemberment (§ 108, 109) does not apply to the ovum of oviparous animals, nor to the seed. They are endowed with the whole essential organization, and maturity of the vital principle, for independent life. The former gets its nutriment from the parent, till the organs are brought forth. The latter are supplied with nutriment from within themselves. In this case, also, the species are destined for great multiplication and distribution; in the other, their numbers and sphere are more circumscribed.

Nevertheless, the germ of all animals contains within itself the principle of carrying out the full development of a being similar to the parent, in all its complicated parts, which, however, have no rudimentary existence in the ovum. The progress, too, of fœtal development is always the same in each species, and every part is brought forward in the order of its importance in the organic life of the fœtus, and of its future uses. It is the same in the vegetable kingdom.

123. The history of the seed and egg probably supplies one of the most remarkable illustrations of Design that can be found in nature; especially that of the seed. They are the only instances where the entire properties of life cease their ordinary operation without becoming extinct; and were it not for this interval of repose, the species would probably disappear; since, even if the properties of life carried out the development of the seed into the plant, the chances of preservation, and especially of multiplication, would be vastly diminished (§ 633, 1051, 1052).

124. Besides the foregoing general division of the organs and functions of living beings, another arrangement of the organs is founded upon the relation of special functions. Each component part, each group of organs, and the whole collectively, are replete with various and wonderful Design; each, and all, having peculiar ends, all conspiring to common ends, and in one harmonious Unity of Design maintaining the life of each other.

125 The following is

The Arrangement of Organs according to their relative Functions.

1. Nervous System.
   - Brain and cerebral nerves.
   - Spinal cord and its nerves.
   - Sympathetic ganglia and sympathetic nerve.

2. Vascular System.
   - Heart and its Pericardium. Arteries. Veins. — Direct circulatory organs.
   - Lymphatics. Lymphatic glands. — Destined for waste.
   - Lacteals. Lacteal glands. — Conveying the means of repair.

3. Digestive System.
   - Mouth, stomach, intestine.
   - Salivary glands and pancreas.
   - Liver.
   - Spleen.

4. Respiratory System.
   - Larynx and vocal system.
   - Trachea.
   - Lungs.
   - Diaphragm.
   - Muscles of thorax and abdomen.

5. System of voluntary muscles.

6. Cutaneous System.
   - Derma, or main portion.
   - Papillary tissue.
   - Rete mucosum.
   - Epidermis.

7. Urinary System.
   - Kidneys.
   - Ureters.
   - Bladder.
   - Urethra.

8. Special Sensitive System.
   - Organ of hearing.
   - " sight.
   - " smell.

9. Osseous System.
   - Bones.
   - Cartilage.
   - Ligaments.
   - Synovial capsules.

10 Genital System.

Male.
- Testes. Ductus deferens. Seminal vesicles. Prostate gland. — Formative.
- Penis. Muscles of perinæum. — Copulative.

Female.
- Ovaries. Fallopian tubes. Uterus. — Formative.
- Vagina. Hymen. Clitoris. Nymphæ. Labia. Constrictor vaginæ. — Copulative.
- Mammæ,—accessory parts.

126. The organic and animal functions are also naturally subdivided into,

1st. Those which operate from without inward, as in digestion; and,

2d. Those which operate from within outward, as in circulation, secretion, &c.

127. There are generally two sets of organs for the animal functions, having a harmony of action in their natural and healthy states.

128. When the organs of organic life are in pairs, as the kidneys, concerted action is not necessary; and here one organ may supply the place of both (§ 109).

129, *a*. The whole assemblage of organic viscera act together in concert; but the animal organs, as a general system, act more or less independently of each other.

129, *b*. The mutual relations which subsist between the various organs and their several functions are of two principal kinds; namely, the vital, and the mechanical.

129, *c*. The first class of relations may be distributed into three different orders. The first order consists of the relations between the organs of sense. The second order embraces those between the brain and voluntary muscles. The third order comprises the relations which are especially maintained by sympathy. It is the last subdivision, mostly, which is relative to our present subject. It concerns, therefore, the organization by which organic life is carried on in animals, and depends upon the nervous power in its function of sympathy, and upon a principle independent of the nervous power, called *continuous* sympathy, and which is probably also an important principle in plants (§ 111–113, 222, 233, 495–500, 638½, 818½).—Note U.

129, *d*. The vital relations of a general nature evince the highest order of Design. They refer to the mutual co-operation of distinct systems of organs in the production of particular results, and of these various systems in the maintenance of universal life; while the several individual organs possess distinct and specific offices that are more or less dependent upon the principle of sympathy (§ 222–233, 455), that is, reflex action of the nervous system.

129, *e*. The sympathetic relations are most strongly pronounced among organs which concur together in the performance of special functions, as the circulatory, the digestive, the urinary, the sexual systems, &c. (§ 124). Other special relations subsist between the brain and the organs of animal life through the medium, in part, of the mental functions. Such is seen between the brain and voluntary muscles in the production of voluntary motion (§ 500, *d*). Thus, also, the senses aid each other; the sight being most independent. In this way, too, a concurrence is established between the teeth, muscles, eyes, nose, &c., in procuring food and supplying the stomach, each individual part having been also constituted with a reference to the nature of the food, and the mode of obtaining it (§ 323).

129, *f*. Plants are devoid of all that intimate association of parts which is owing to reflex nervous influence in animals, as well as to peculiarities of structure and special modifications of the common properties of life. But, a general relation of functions obtains to a certain extent in plants through the law of *continuous* sympathy, which, as I have endeavored to show, depends upon the organic properties and which I would designate as *continuous influence* (§ 498).

129, *g*. The sympathetic relations in organic life are of the very highest moment in medicine. Disease is propagated, is maintained, and removed, very greatly, through these natural relations.

129, *h*. The sympathetic relations are variously modified by disease, and are often more strongly pronounced than in health, though more or less diverted from their natural condition. Remedies also operate with greater effect through these modified relations, as well as through the greater susceptibility of the organic properties (§ 137, *d*). For the same reason, natural stimuli, as food, often prove morbific in diseased conditions (§ 152, *b*). The sympathies which grow out of morbific agents depend upon the natural principle, of which they are only modifications. And so of those which spring from remedial agents; these agents giving rise to greater influences in consequence of the morbid state of sympathy and of the organic properties, as well as in consequence of their own intrinsic virtues (§ 718, 901).

129, *i*. It appears, therefore, to be a most important law, that morbid states call into operation reflex nervous actions among organs, which, in their natural state, manifest but feeble, and perhaps no direct relations whatever; and that, in consequence of morbid changes, remedial agents will operate sympathetically through the stomach, &c., upon remote parts, when they would have no such effect in the healthy state of the organs. This principle is demonstrated in every case of disease, and constitutes our first position against the humoral pathology, and the doctrine of the operation of remedial agents by absorption (§ 819, &c.). New vital relations being developed by disease, our remedies continue to operate through those acquired relations so long as they exist; while, also, the remedies themselves may institute analogous sympathetic relations, and thus simultaneously induce reflex nervous actions of a salubrious nature in organs not morbidly affected (§ 74, 117, 137, 143, 155, 156, 387, 422, 514 *h*, 524 *d*, 525, 528, 733 *b*, 905, 980).

129, *k*. The *mechanical* relations are equally common to plants and animals. They are maintained by the motion of matter from one organ, or part, to another; as the transmission of blood from the heart through the blood-vessels, sap from the roots to the leaves of plants, food through the intestinal canal, urine from the kidneys to the bladder, and from the bladder through the urethra, &c. But, the movement of the matter is effected by the vital properties operating through the various organs.

130. Every part is a perfect labyrinth, anatomically considered. It is a labyrinth, also, of perfect designs; while the harmonious concurrence of these designs in the aggregate organs and tissues is too profoundly complex for any exact analysis. The deep intimacy of parts in each tissue corresponds with the union of the whole, with the dominion of common laws, and with that concerted action of all parts, which, in a popular sense, makes up the life of the organic being.

131. It has already been stated, that a knowledge of the minuteness of structure which is supplied by the microscope is practically useless, while the deceptions of that instrument have led to many important errors in physiology and pathology (§ 83). It cannot be depended upon, especially, in exploring soft structures. If it lead to unimportant facts, it is equally liable to betray us into error and fal-

lacious hypotheses. The whole history of that instrument, so far as physiology is concerned, has gone to confirm the foregoing conclusions, which were originally advanced in another work, and has conclusively sustained the opinion of one of the most profound observers of the present age. Thus:

"Authors," says Bichat, "have been much occupied with the intimate structure of glands. Let us neglect all these idle questions, in which neither inspection nor experiment can guide us. Let us begin the study of anatomy where the organs can be subjected to the senses." "No methodical mind will attend to the minute nature of the muscular fibre, upon which so much has been written. The exact progress of the sciences in this age is not accommodated to those hypotheses, which made general anatomy and physiology a frivolous romance in the last."

Microscopical information, so far as correct, goes to the amount of human knowledge, and to the perfection of science, though it may not contribute to useful ends. But experience shows us that we may not depend, as it respects the microscope, upon the vision of others, especially where a high magnifying power is required. Each must observe for himself; and, as allowed by Ehrenberg, long practice, alone, can assure him of any general accuracy. The laborious student may attend to this accomplishment. But, *vita brevis, ars longa;* and he will be likely to live the subject of deluded sense rather than of enlightened understanding.

> "Enough is left besides to search and know.
> But knowledge is as food, and needs no less
> Her temperance over appetite, to know
> In measure what the mind may well contain;
> Oppresses else with surfeit, and soon turns
> Wisdom to folly, as nourishment to wind."—MILTON.

The following is another example in illustration of Milton's principle, and another instance* of the revolutionary spirit of the microscopic observers. I quote from Wagner's "Elements of Physiology for the *Use of Students.*"

"The study," he says, "of the VARIETIES OF FORM presented by the *seminal animalcules* ought not to be held as any trifling matter, or as tending to accumulate superfluous details. MOST IMPORTANT PHYSIOLOGICAL CONCLUSIONS may be BASED on the information thus acquired" (§ 83, *b*).

It is one of the few correct physiological conclusions to be found in the writings of Liebig, that

"The most exact anatomical knowledge of the structure of tissues cannot teach us their uses; and from the microscopical examination of the most minute reticulations of the vessels, we can learn no more as to their functions than we have learned concerning vision from counting the surfaces on the eye of a fly."—LIEBIG'S *Animal Chemistry.*—(§ 83 *c*, 251, 699 *c* and *d*).

When we consider, therefore, the constant deceptions of the microscope, especially in all explorations of soft substances, and the absolute uselessness of any knowledge it may convey as to the recesses of organization, it may be reasonably expected that the time is not

* See article on the Microscope, in *Medical and Physiological Commentaries*, vol. i. p 699–712; and my *Examination of Reviews*, p. 6, 89; also, this work, § 515.

distant when all this lumber will be excluded from practical works on physiology, and turned, at least, into a channel by itself.*

132. Each simple texture, when united into compound organs, has as much its own specific function as the aggregate compound. It is even more important, in a pathological sense, to regard the individual textures than the compound organ which they may form.

133, *a*. A consideration of the tissues in respect to their special character and functions, as well as their obvious anatomical differences, being of the very highest importance to the physiologist and physician, they can be studied advantageously only in these several aspects. Much must, therefore, be now anticipated as to what will be subsequently stated more circumstantially in regard to the properties and functions of life. The student must be prepared with that analysis before he can approach the tissues with any hope of enlightened knowledge. A simple statement of their apparent anatomical characteristics and relations, and of their products, would present a barren field. Nor is it alone their vital attributes which should most engage the attention of the medical philosopher, but he should be equally and simultaneously employed in learning how these conditions are modified in disease. Such, therefore, is my projected plan in relation to the tissues (§ 83, *c*).

133, *b*. Every distinct tissue, and often the same tissue as it occurs in different places and connections, and even the different parts of one and the same continuous tissue, possess, respectively, special modifications of the vital properties and functions. Upon these modifications depend the variety of the natural vital phenomena, as, also, very greatly, those which are morbid.

133, *c*. But there would be no disease were there not another important condition in the constitution of the vital properties; and this is their mutability. Its final cause is the well-being of organic nature; since, as organization changes in the progress of the plant or of animals to a state of maturity, so must there be an antecedent change in the properties which conduct the development of organs, &c. The same principle is displayed in gestation, lactation, &c. It is this, in connection with the susceptibility of the properties of life to the action of blood and other vital agents, which renders them liable to morbid changes when other causes operate. Such, therefore, is a necessary consequence of the final cause of the adaptation of the properties of life to the influence of salutary agents, and to the varying exigencies of organic nature.

Nor would there be any recovery from disease, but for the same mutability of the organic properties, and their liability to other changes when yet other causes operate (§ 177, &c., 901).

134. Owing to the peculiarities in the vital constitution of the different tissues, a common disease, as inflammation, is characterized by many peculiarities of symptoms, &c., in the several tissues, respectively. Differences also arise in their constitutional influences, and they may require corresponding variations of treatment (§ 718). This is even true of different parts of a continuous tissue, as the alimentary and pulmonary mucous membrane; where inflammation of this membrane in the nose, larynx, trachea, lungs, fauces, stomach, and intestines, is distinguished by almost as striking peculiarities in the vital signs, and in their constitutional influences, as are the physiological

* Not one disclosure has been yet made by the microscope that can affect a doctrine in these Institutes—1870.

functions of the different compound organs which it traverses (§ 140 752–754, 780, 783).

135, *a*. The special modifications of the vital properties in different parts of one and the same continuous tissue is often strikingly denoted by the character of the natural product of the several portions, respectively; as in the tissue last mentioned. Nothing, for example, can be more unique than the gastric juice, a product of all complex animals, while it can be generated by nothing but the mucous tissue of the stomach. Again, in the lungs we meet with this tissue performing the office of excretion; being the only example in which an organ eliminates truly effete matter from venous blood. And here an important analogy occurs to show that the elaboration of carbon is a vital process (§ 316, 419, 827 *b*). In the uterus the same membrane appears as an organ of excretion in relation to the arterial blood, but for the uses of the uterus alone; nor is there any thing else in nature that is capable of generating a similar product. But, in all the cases, the analogy which is indicated by the coincidence of anatomical structure is farther confirmed by the universal production of mucus by this remarkable tissue. The anatomical differences are microscopical.

135, *b*. All the foregoing is delicately exemplified by the great variety of formations which are generated by the granulations that spring from ulcers; since, although in all the cases the granulations appear to be identical in character, we know from their production of parts analogous to such as had been removed by the ulcerative process, that, in every instance, the granulations must have been endowed, respectively, with specific modifications of the organic properties and shades of difference in organic structure (§ 733 *c*).

136. In consequence, also, of the foregoing peculiarities of vital constitution, every tissue, and often continuous parts of a tissue (as in the last example), are determined in their results by special vital influences, as well as by any peculiarities of organization. This is denoted by the phenomena where structures are most alike. Owing, also, to the general coincidence in the vital constitution of all parts there are certain general stimuli adapted to the whole, especially the stimulus of heat. The blood has been regarded as a universal stimulus; but, it is only so in relation to the sanguineous system. This fact, it may be now remarked, evinces, what is shown by diseases, a near identity in the vital constitution of all that part of the arterial system which conveys red blood; while, on the other hand, the difference between arterial and venous blood shows a difference in the organic properties of the arterial and venous systems. This has its deep foundation in the whole physiological condition of man and animals, and I may also add, in the whole vegetable tribe (§ 847, *c*). While every surface has some secreted product adapted to its own special modification of irritability, many of these products may be offensive to other parts. Again, the special irritability of one part may be exactly suited to some product of another part, and this may or may not be a natural vital stimulus, and perfectly inoffensive, to the second part, while it may excoriate all other parts. Bile, for instance, is the natural stimulus of the intestine, but will injure other parts. Venous blood is harmless in the veins, and excites them, more or less, to a contractile action; but is rapidly fatal within the arteries (§ 849). Urine is the natural stimulus of the bladder, but will excoriate most other parts (§ 74, 188½ *d*, 475½, 500 *m*, 514 *f*, 647½, 650, 847 *e*).

137, *a*. In this relative sense the animal is filled with poisons; each one of which, however, in its proper place, is not only inoffensive, but indispensable. Here is the principle.

137, *b*. It is, also, upon the foregoing organic constitution of different parts, and which gives rise to a mutual relation of the different vital agents and products of organs and of the various parts of the organism, that the difference in the effects of remedial as well as morbific agents upon different parts is essentially founded. Wine inflames the mucous tissue of the bladder, &c., but may be good for the stomach. Tobacco smoke is inoffensive when inspired in the ordinary mode; but it is a violent poison when introduced within the alimentary canal. Other agents affect the stomach, or intestines, or liver, or uterus, or bladder, &c., each organ more than the others, and more than other parts (§ 233¾, 872 *c*, 838.)

137, *c*. From not duly regarding these important facts, or from an ignorance, or a disregard of physiology, many agents which have a specific relation to the vital constitution of some tissue in a particular part of the body, as the mucous, for example, are supposed to have the same relation to the tissue in all other parts. Hence the oil of turpentine, copaiva, naphtha, &c., have been abortively or injuriously employed in pulmonary catarrh, phthisis even, diarrhœa, dysentery, &c., mostly for the reason that they exert a specific effect upon the mucous tissue of the urinary organs.

This great law of adaptation is so universal as to extend throughout the whole domain of medicine, reaching as fully into pathology and therapeutics as it is conspicuous in physiology. If the blood be rendered morbid by morbid states of the solids it never becomes morbific, since there is a progressive adaptation of the vital changes in the solids to such as the solids induce in the blood. And so of various morbid secretions in relation to the parts by which they may be produced. These results, in which the vital properties of the solids are always concerned as the primary cause, are founded in an all-pervading law of the animal economy, and by which, and which alone, nature is enabled to throw off disease (§ 524 *d*, 944 *c*, 847 *a–h*).

137, *d*. Again, it is one of the most important laws in medicine, that the susceptibility of tissues and organs to the action of remedial agents is more or less affected by disease. Many agents which operate powerfully in certain morbid states, and in certain doses, both locally and sympathetically, may be perfectly inert in the natural states of the same organs. And so of the natural agents of life. The greatness of the effects, also, will depend very much upon the nature and intensity of disease. The same principle applies to the impressions which are made by many remedial agents upon existing states of disease, or upon organs in their state of integrity; by which the diseased or healthy parts are increased in their susceptibility to the subsequent action of the same or other remedies, or to morbific causes (§ 143, *c*).

137, *e*. It is, therefore, one harmonious system of laws throughout. Were it, indeed, otherwise, remedial agents could have no existence, and disease, of course, could receive no help from art. These, also, are the beginning of a long series of facts which show us that the effects of all agents, whether morbific or remedial, may be traced to the peculiar impression which they exert upon parts with which they come in contact; and by which, also, we overthrow the whole system

of chemical physiology, the humoral pathology, and the doctrines of debility, and of cure by the absorption of remedies (§ 847, *e*).

138. The natural modifications of the vital properties and functions, or the special vital constitution, of any particular tissue, or parts of a continuous tissue, and, therefore, their special modifications in any given disease, conform to the general nature of the complex organ of which the tissue may form a component part.

Certain tissues of a compound organ are far more liable to disease than its other tissues. Thus, the mucous tissue of the stomach is quite liable, the serous rarely, and the muscular more rarely (§ 764, *a*)

139. Disease of any particular tissue, or parts of a tissue, is apt to be most severe, in its local and general character, according to the importance of the functions of the *compound organ* of which it may form a component part. This, however, is less true of the constitutional influence, than of the local intensity of disease.

140. The sympathetic influences of disease are also greatly determined by the nature of the affection, especially the constitutional effects. Inflammation of the serous, venous, and ligamentous, tissues, disturb the constitution far more than the same degrees of inflammation affecting the mucous, arterial, and muscular, tissues. But much, also, as already said, will depend upon the nature of the compound organ with which the tissue, or part of a continuous tissue, may be associated; though sometimes, where the compound organ is comparatively unimportant, inflammation of one of its tissues may give rise to great constitutional disturbances. Such, for example, is true of some inflammatory affections of the mucous tissue of the throat; and few diseases are more intractable than laryngitis. Much, also, will often depend upon the special modification of disease; as in acute articular rheumatism (§ 525–530).

141, *a*. Tissues of the same organization are most allied in their vital properties, and hence are most liable to sympathize with each other in their diseases.

141, *b*. When a tissue of an organ becomes diseased the properties and functions of the others are more or less disturbed; though the primary disease is not apt to be propagated to them from the tissue first affected. It continues rather in the tissue first invaded. Inflammation, for example, beginning in the mucous tissue of the stomach, will extend along that tissue, so far at least as its connection relates to the stomach, without being often propagated to the other tissues of the compound organ. This principle has a broad foundation, and is owing to the general coincidence in the vital constitution of all parts of the same tissue, and to the differences between the vital states of that and the associated tissues. Exceptions, however, occur more frequently in some parts than in others; as in the lungs, where pleuro-pneumonia is not unfrequent. Nevertheless, in these cases, the simultaneous affection of two distinct tissues of a compound organ may be rather owing to a general predisposition effected by some remote cause than to morbific influences exerted by one tissue upon the other. In other cases, especially of specific inflammation, the disease is propagated directly from one tissue to another, as in scrofula, heumatism, &c.; but in most other instances by reflex nervous action.

142. For reasons stated in § 133–136, morbific agents may readily excite disease in one part of a continuous tissue when they would have

no effect on another part of it; or may operate more profoundly on one part than on another. And this holds true of the action of remedial agents. The same is also true of the sympathetic influences which may be exerted by disease; and a like principle applies to certain sympathies that fall upon special parts which are immediately continuous with each other, but which are determined, also, by certain special vital relations of the different parts. Thus, the vital relations of the tongue to the alimentary canal being far greater than to the lungs, and as the canal readily sympathizes with other chylopoietic viscera, the tongue is far more sensitive to abdominal than to pulmonary derangements (§ 129 *c*, *i*, 689 *i*, 694$\frac{3}{4}$).

143, *a*. Again, there may be varying susceptibilities of the different parts of a continuous tissue (arising from numerous causes not positively morbific), when the same morbific, or remedial, cause will affect one part or the other more in conformity with the acquired susceptibilities, than with the natural modifications, of the vital properties in the several parts, respectively. This is also more applicable to the tissue as it occurs in compound organs not anatomically connected, and to tissues which differ in their organization (§ 783).

143, *b*. Hence it follows, that, if all the organs be rendered preternaturally susceptible, a general explosion of disease may follow the operation of some cause, which, in sounder health, would be harmless. Under these circumstances, however, disease is most apt to spring up more or less sympathetically, and successively, in one part after another, till all parts may ultimately be brought into some, though variable, forms of disease (§ 514 *h*, 660, 666, 905). But, in these cases, it generally happens that some of the morbid states abate, or subside, as new ones come forward, the new ones, perhaps, subduing sympathetically the older in the series (§ 804, 905). The system, therefore, is rarely universally invaded by disease, except in idiopathic fever (§ 148, 783). Reflected nervous action applies in all the cases.

Nevertheless, it probably does not often, if ever happen, except in fever, that the primary is the efficient predisposing cause of universal disease, but that disease of one organ proves the predisposing of disease in another; and as one organ after another becomes affected in this manner, they co-operate together in rendering other parts susceptible of disease (§ 644, &c., 715–719).

143, *c*. In proportion, therefore, as the susceptibility of the system at large is increased by morbid changes, or predisposed by morbific influences, so, in a general sense, will the alterative action of remedial agents be felt in a corresponding manner (§ 137 *d*, 152 *b*, 715). By the law of adaptation as set forth in the *Medical and Physiological Commentaries* (vol. i., p. 649, 653–655, &c.), and in various parts of the present work, the sympathetic influence of any local disease which is felt by distant organs modifies the vital states of those parts in a manner that institutes harmonious relations to the part more profoundly affected; and thus remedial agents will extend their salutary alterative action to such distant parts, and render them the source of salutary effects upon the essential seats of disease (§ 73, 80, 117, 129 *i*, 133–137, 140, 155, 156, 169 *f*, 387, 399, 422, 514 *h*, 524 *d*, 525, 528, 638, 649 *d*, 811, 848, 902 *f*, 905). When the whole system is invaded by disease, as in idiopathic fever, the alterative action of remedies is felt over the universal body (§ 148, 152 *b*, 222–232, 500,

904 *d*). It is owing, also, to the same law of adaptation, the same universal, however partial modifications of the vital states which local diseases often induce, that parts remote from the direct seat of disease are protected against all morbific effects from any changes which the blood may undergo as a consequence of morbid action (§ 845, &c.).

Independently, however, of any increased susceptibility of organs, the action of numerous agents upon the stomach may determine influences upon distant parts whose natural state is unimpaired, and these influences may become the source of other impressions upon other parts. Circles of reflex nervous action may be thus engendered universally, by which all parts shall concur in the effects of the gastric irritation which the remedies may institute. In this manner a cathartic or an emetic may bring the whole organism to bear with favorable influences upon some slight inflammation of the throat which had exerted no modifying effects upon other parts (§ 514 *h*, 692 *a*, 902 *g*).

143, *d*. Again, there are some remedial agents possessing general vital relations to the whole body, especially the several preparations of mercury, and others whose specific relations are more limited, like cantharides, which will affect profoundly the entire organization, or certain individual parts, and alter the condition of their vital states, in the most healthy conditions. These agents, therefore, approach most nearly the truly morbific ones, while they possess the grand characteristic of the Materia Medica of instituting morbid changes which are of transient existence (§ 1059, 854 *d*).

144. Many acquired conditions may be transmitted from parents to child, which may thus form a constitutional predisposition to disease; being a permanent and more or less universal modification of the vital properties (though of some parts more than others), which does not properly belong to them; as in scrofula. Here, the absolute remote cause has operated upon the ancestor (§ 75–80, 661).

145. Subjects thus constituted (§ 144) are liable to morbific influences which the more natural do not feel; and such causes as would produce in the natural subject common inflammation of the nose, trachea, &c., will excite scrofulous inflammation in the lungs of the acquired constitution (§ 650, 659).

146. Hereditary predisposition to disease manifests itself in certain tissues and organs more than in others, according to the nature of the transmitted constitution (§ 143, *a*).

147. Sympathetic diseases may spring up in unusual constitutions, when they would not in the more natural. Thus, in certain hereditary conditions indigestion gives rise to scrofulous, rheumatic, and gouty inflammation of parts distant from the chylopoietic viscera. The same principle is also in operation when the vital constitution of parts is modified by habits, climate, age, the development of the generative organs, &c. (§ 542), all depending upon reflex nervous action.

148. Certain causes appear to be capable of affecting, directly and indirectly, all the tissues of the body, as in idiopathic fever; though, in these cases the primary morbific effect is on particular parts, from which it is disseminated by morbific reflex nervous action (§ 649, 665, 666, 760). In these cases, however, it appears not to be a positive state of disease in the part upon which the morbific agents may exert their primary effects, as on the mucous surfaces, which brings the rest of the system into a predisposition to disease; but a predis-

position being established in those primary parts, the impression is of such a nature as to be propagated sympathetically over the universal body; just as when many remedial agents acting upon the mucous surface of the stomach exert powerful influences upon remote organs, but without inducing disease in the gastric mucous membrane. It is, therefore, in idiopathic fever, as well as in numerous local affections, that the parts on which the morbific agents exert their direct effects may not manifest any signs of disease till the explosion of fever takes place; or as when pneumonia, or catarrh, is induced by the action of cold upon the skin; while it often happens that the parts thus originally, but imperceptibly impressed, become sympathetically the seats of absolute disease by the reacting influence of the diseases which had been sympathetically produced through these parts. Very complex circles of reflex nervous action may thus arise. These general affections may be also broken up by the action of a single remedy, as by an emetic, or mercury, &c. (557, 559, 712, 715–719).

149. It is a great and important law, resulting from the physiological considerations now made (§ 133–148), that morbific causes, external or internal, determine disease upon the tissues of one compound organ or another according to the particular virtues of the morbific causes, and in accordance, also, with the natural modifications of the vital properties in every part, and the susceptibilities which they may acquire from other causes (§ 642 *b*, 722 *d*, 725, 794, 795, 808). Hence it follows that many of the natural stimuli of life may become morbific.

150, *a*. It is a great fundamental law, that a general coincidence exists between the natural susceptibilities of the properties of life to their ordinary stimuli (§ 136), and to those of a morbific, and of a remedial, nature, according to the natural modifications of the vital properties, whether in a general sense (§ 148), or in their relation to particular parts (§ 136); the influences produced conforming, of course, to the natural modifications of the properties of life and the special virtues of the several agents, though modified by the transient or permanent influences which spring from other sources, especially from disease (584, 644–674, 772 *c*, 826, &c., 847 *e*, 904).

Such is the inevitable result of the constitution of the properties of life (§ 177). It is, as it were, the great focal point from which all diverges that is embraced in medicine; the bond which unites every branch of the science.

150, *b*. All that is here said, and in § 149, is equally applicable to the nervous power, in all its modifications, as an agent in the production and cure of disease, as to agents of a physical nature (§ 222–233¾, &c.).

151. It is through the foregoing law (§ 150) that the natural stimuli of life maintain all parts in their precise conditions; through which, also, morbific agents alter those conditions in certain uniform ways, and through which remedial agents establish certain other changes which enable the properties and actions of every part to return spontaneously to their natural states. The law involves an immense range of facts in physiology, pathology, and therapeutics, and groups many other fundamental principles. It should be the point of departure in all our medical researches and reasonings; for it is, as it were, the polar star which will guide us safely upon our difficult and dangerous voyage (§ 794, 795, &c.).

152, *a*. It follows, therefore, from § 150, 151, that the operation of all things upon the living organism, whether food, heat, cold, blood poisons, the nervous power, or remedies for disease, is upon one common principle, which is relative to the natural constitution of the organic properties. Food stimulates the stomach, and throws a genial sympathetic influence over the whole organism, warming the cold surface as soon as it enters its appropriate receptacle; blood maintains, in the same way, the actions of all parts; poisons and morbific agents, put into the stomach, affect the vital properties of that organ injuriously, when, unlike the case of food, pernicious reflex nervous actions are determined upon other parts, or the same food in excess may do the same. We then introduce into the same organ another class of morbific agents that are less profound in their operation, and which prove remedial in certain doses, and therefore establish, through the same principle, a salutary change in the same properties which other poisons had affected injuriously (§ 638, 642 *b*, 854).

152, *b*. It is also worthy of repetition, that such is the analogy between morbific and remedial impressions, that the organs which sustain the former are thus rendered susceptible of the latter, when they might be otherwise insensible to the same remedial agents, in their appropriate remedial doses. Such is the harmony of the laws of nature; such their great final causes (§ 524, no. 3, *d*). For the same reason, also, many of the natural agents of life, such as the ordinary kinds of food, may be intensely morbific in most of the diseases of man (§ 849). Or, again, the agents which heal in their remedial doses may establish severe forms of disease when administered in health.

153. Through the law of development, the tissues undergo natural modifications in their structure and vital endowments at many periods of life. In infancy, the organs are imperfectly developed, though the properties and functions of organic life, unlike those of animal life, are strongly pronounced in many of the viscera. A relation obtains, however, in organic life, between the properties and functions and the relative size of organs (§ 159).

In childhood, there is another well-marked change. In adolescence, another; when the organs become mature. In old age, another; when life is naturally on the decline.

154. The foregoing stages of development (§ 153) are not sudden, but gradually progressive.

155. The changes of organization (§ 153, 154) are preceded by corresponding changes in the vital properties, upon which the former depend (§ 445, *f*). This principle, too, like all others which relate to organic life, whether in health or disease, is universally true under any given combination of circumstances. It is true of the development of all tissues and all organs, and all other products, from the beginning of conception to the end of life. Hence, also, the variety in the remedial or morbific virtues of many plants, at different stages of their growth. As structure varies, the vital properties have undergone modifications, in conformity with that order of Design which was instituted, that where one specific end is accomplished, and others are to be fulfilled, the powers by which these final causes are to be accomplished shall have their necessary adaptations. And while, also, the vital properties, under all their natural modifications, are so constituted as to receive certain exact impressions from the natural stim-

uli of life, that vital actions may be determined according to the purposes ordained, so also will morbific and remedial agents be varied in their influences (§ 129 *i*, 387, 980).

156, *a*. The foregoing variations (§ 153–155), therefore, give rise to new dispositions to disease in many parts, and are productive of modifications of former diseases, or the latter disappear. This, as we have seen, is a necessary consequence of the physiological changes, since the same properties which carry on nutrition and growth carry on all diseases. The relations of vital and morbific agents move on, *pari passu*, with the natural changes in the properties of life; and remedial agents undergo corresponding modifications of action.

156, *b*. The great law of adaptation is forever present to the eye of the naturalist; and when the same subjects are contemplated in a moral sense, the same evidences of Design meet him at every glance of the mind. Take an example of a compound nature, a universal physiologico-moral phenomenon in which our present topic is involved. Thus, no sooner was man created than he was doomed to obtain his subsistence by the sweat of his brow. Roots, grains, fruits, &c., were, therefore, as far as the wants of animals would allow, created mostly in an unedible condition, but rendered susceptible of the requisite improvement by cultivation; and to carry out the great purpose, the nature of soils, air, water, &c., were made subservient (§ 74, 80, 117, 137, 143, 155, 169 *f*, 266, 384, 385, 387, 399, 409 *f*, 422 514 *h*, 524 *d*, 525, 526 *d*, 528, 638, 733 *b*, 847 *g*).

157. Organs are softest and most fluid at the beginning of their development, and increase, progressively, in density through life. The animal ovum is scarcely more than an organic fluid (§ 67).

158. Vascular action is promoted by the greater fluidity of organs, and *vice versa* (§ 142). Inflammation is in part, therefore, more intense and rapid in infancy and childhood than at later periods, which, with other causes, gives rise to the necessity of great promptitude of remedies. Other causes attending the vital conditions of old age render equally important a decisive treatment of the severe diseases that may befall that age (§ 574, &c., 1009, &c.).

159. The proportional size of organs varies at different stages of life. The cerebro-spinal system, for example, is largest in childhood. Hence a greater development of the organic properties in those parts, and a greater consequent liability of the brain to inflammatory and congestive affections, and to hydrocephalus. The large proportional size of the nervous and arterial systems affects the physiological and pathological condition of all other parts; giving activity to nutrition, and susceptibillty and intensity to disease.

The glandular tissue of the liver has the largest proportional size in infancy; but not so the venous system of the liver. Hence, again, the glandular function of that organ is especially liable to derangement in infancy, and its venous tissue to congestion at more advanced ages.

It is also important to understand, that the veins, in a general sense, "have a real inferiority as it respects the arteries, during the first periods of life."—Bichat. There are some exceptions, especially in the brain.

160. What has now been said of the modifications of the vital constitution of different tissues and organs may be illustrated by the rel

ative liability of different tissues, and parts of common tissues, to some given disease, by the relative danger of that disease as it may affect the different parts, and by the effects of some remedial agent upon the various parts, respectively. The remedy may be loss of blood, and the supposed disease inflammation. The statement may be conveniently made in a tabular form, while, also, it may be converted to practical uses (§ 711).

161. The tables are intended in a general sense, and suppose the constitution to be naturally sound. If hereditary predispositions to disease exist, as in scrofula, or if the constitution be affected by intemperance, or by previous diseases, &c., the order of liabilities to inflammation, &c., as marked in the first table, will be more or less affected. In the scrofulous constitution, for example, instead of the mucous, the lymphatic tissue may be most liable.

162. The tables will be more or less modified by age. Thus, the veins of the pia mater are more liable to congestion in infancy and childhood than any other part of the venous texture. This liability afterward decreases, and returns at the age of fifty and upward, resulting in cerebral hemorrhage (§ 805).

PHYSIOLOGICAL AND PRACTICAL SUGGESTIONS.

Tissues most liable to disease, especially to inflammation, in the order of arrangement:

TABLE I.

1. Mucous.
2. Venous (*venous congestion*).
3. Cellular.
4. Serous.
5. Ligamentous and dermoid (*fibrous*).
6. Glandular.
7. Lymphatic.
8. Nervous.
9. Synovial.
10. Periosteum (*fibrous*).
11. Osseous.
12. Tendons, cartilage, dura mater, and pericardium (*fibrous*).
13. Muscular.
14. Arterial.

TABLE II.

1. Mucous texture . . . . of the nose.
   " lungs, fauces.
   " eyes.
   " small intestine, Ilium, Jejunum, Duodenum.
   " stomach.
   " large intestine.
   " uterus and vagina.
   " bladder.

- 2. Venous texture (forming, mostly, venous congestion) . . . . .
  - of pia mater, in infancy and childhood.
  - " liver.
  - " small intestine.
  - " pia mater of adults.
  - " rectum (*piles*).
  - " uterus (*phlebitis*).
  - " lungs (*congestive asthma*).
  - " lower extremities (*varix*).
  - " spermatic cord (*circocele*).
- 3. Cellular texture . . .
  - sub-cutaneous.
  - of the lungs.
  - " pia mater.
  - " voluntary muscles.
- 4. Serous texture . . . .
  - of the lungs.
  - " parietes of thorax.
  - " parietes of abdomen.
  - " liver.
  - " small intestine.
  - " large intestine.
  - " heart and pericardium.
  - " cerebral ventricles.
  - " kidneys.
  - " stomach.
- 5. Glandular texture . . .
  - lymphatic glands.
  - mammæ (*puerperal*).
  - salivary glands.
  - liver.
  - testis.
  - lacteal glands.
  - kidney.
  - thyroid gland (*goitre*).
  - thymus gland.
  - pancreas.
- 6. Lymphatic texture . .
  - of the lower extremities.
  - " upper extremities.
  - " uterus (see *Comm.*, vol. ii., p. 470)
  - others rarely.
- 7. Fibrous texture . . . .
  - ligaments.
  - dermoid.
  - periosteum.
  - cartilage.
  - tendons.
  - pericardium.
  - dura mater.
- 8. Nervous texture . . .
  - brain.
  - nerves.
  - ganglia of sympathetic.
  - spinal cord.
- 9. Synovial texture . . .
  - of the knee-joints.
  - " ankle.
  - " joints of upper extremities.
- 10. Osseous texture . . . .
  - spongy bone.
  - solid bone.

11. Arterial texture . . . . { of the brain. / arch of aorta. / " extremities. / rare in other parts.

TABLE III.

Relative danger of high inflammation affecting the tissues of different organs, according to the order of arrangement:

1. All textures of the brain.
2. All textures of the heart and pericardium.
3. Venous and lymphatic textures of the womb, iliac and other veins.
4. Peritoneum of abdomen (*puerperal women*).
5. Serous membrane of small intestine.
6. Veins of the liver (*venous congestion in congestive fevers*).
7. Parenchyma of lungs.
8. Glandular texture of liver.
9. Mucous texture of small intestines.
10. Mucous texture of stomach.
11. Serous texture of large intestine.
12. Textures of kidney.
13. Mucous texture of large intestine.
14. Serous texture of lungs and thorax.
15. Serous texture of liver.
16. Serous texture of abdominal parietes (*common inflammation*).
17. Veins of lungs (*low, or sub-active, forming congestive asthma.* See *Comm.*, vol. ii., p. 494).
18. Textures of bladder.
19. Mucous texture of uterus.
20. Ligaments.
21. Bone and cartilage.
22. Lymphatics of extremities.

TABLE IV.

Tissues which require the greatest extent of general blood-letting, when affected with high inflammation,—according to the organs in which they are associated, and in the order of arrangement. The remedy is supposed to be applied early.

1. All textures of the brain.
2. All textures of the heart and pericardium.
3. Serous texture of small intestine.
4. Peritoneum of abdomen (*in puerperal women*). NOTE H p. 1117.
5. Parenchyma of lungs.
6. Serous texture of stomach.
7. Serous texture of large intestine.
8. Veins and lymphatics of uterus. (*Early.*)
9. Serous and glandular texture of liver.
10. Venous texture of liver. (*Sub-acute, congestion in congestive fever. Often more largely.*)
11. Mucous texture of small intestine.
12. Uterus.
13. Textures of kidney.

14. Mucous texture of stomach.
15. Mucous texture of large intestine.
16. Serous texture of lungs and chest.
17. Serous texture of abdominal parietes. (*Common inflammation.*)
18. Ligaments. (*Often more largely.*)
19. Bladder.
20. Mucous texture of bronchiæ.
21. Mamma, testis, parotid gland.
22. Absorbents of extremities.

163. In the treatment of disease, therefore, we should consider the precise pathology of each affected tissue, the natural vital peculiarities of the affected tissue in the compound organ, its general character as well as that of the compound organ in the animal economy, the influences which its morbid state exerts upon the other tissues in a compound organ, its own morbific influences and the combined influences of the compound organ upon other parts, and how the remote sympathizing parts may react, or shed an influence on yet other parts. And then follows not only the general plan of treatment, but all that nice discrimination of cathartics, emetics, alteratives, and other groups of agents possessing, in their individualities, respectively, analogous virtues, their combinations, alternations, precise dose, frequency of repetition, &c. (§ 675, 685, 686). The same variety of considerations are to be made when the condition of diseased parts may undergo changes, favorable or unfavorable, from the operation of remedial agents.

We are mostly assisted in the foregoing inquiries by comparisons of the morbid with the natural vital phenomena and physical products of each part, and the whole collectively. We also acquire much of our knowledge of the natural constitution of individual parts by observing the deviation of their phenomena when acted upon by morbific or remedial agents. The phenomena are then more strongly pronounced than in health, or new ones are developed. Indeed, it is sometimes through morbid conditions only that we acquire a knowledge of some of the important physiological conditions; as, for example, the existence of common sensibility in all parts. Hence a corollary, that none but an observer of disease can expound the natural conditions and laws of life (§ 685, 686, 848).

THIRD DIVISION OF PHYSIOLOGY.

PROPERTIES OR POWERS OF LIFE.

164. A VITAL, or peculiar governing principle or power, in organic beings, has been recognized by all the most distinguished medical philosophers at all ages of the science. It is the fundamental cause of growth, nutrition, and of all other phenomena of organic beings. It is, in all but the vulgar acceptation, synonymous with the term *life;* and *life*, therefore, is a *cause*, and not an *effect*, as has been assumed by many distinguished physiologists, and as taught by chemistry.

165, *a*. "Until it is proved," says Andral (the restorer of the humoral pathology), "that the forces which, in a living body, interrupt the play of the natural chemical affinities, maintain a proper temperature, and preside over the various actions of organic and animal life, are analogous to those admitted by natural philosophy, we shall act consistently with the principles of that science, by giving distinct names to those two kinds of forces, and employing ourselves in calculating the different laws they obey."—ANDRAL'S *Pathological Anatomy*.

And, to the same effect, the distinguished organic chemist, Liebig, the chief of the school of pure chemistry (§ 4½):

"There is NOTHING to prevent us from considering the VITAL FORCE as a PECULIAR property, which is possessed by certain material bodies, and becomes sensible when their elementary particles are combined in a certain arrangement or form. This supposition takes from the *vital phenomena* nothing of their wonderful peculiarity. It may, therefore, be considered as a RESTING POINT from which an investigation into these phenomena, and the LAWS which regulate them, may be commenced; exactly as we consider the properties and laws of LIGHT to be dependent on a certain *luminiferous matter* or ether, which has no farther connection with the laws ascertained by investigation."—LIEBIG'S *Animal Chemistry*.

So, also, Carpenter, Roget, and other eminent chiefs of the physical school (§ 64).

And thus, the eminent Müller, who leads in the school of chemico-vital physiology:

"The only character that can be possibly compared in organic and inorganic bodies, is the mode in which *symmetry* is realized in each." "Whether the vital principle is to be regarded as imponderable matter, or as a force or energy, is just as uncertain as the same question in reference to several phenomena in physics. Physiology, in this case, is not behind the other natural sciences; for the *properties of this principle* in the functions of the nerves are nearly as well known as those of light, caloric, and electricity, in physics."—MÜLLER'S *Physiology*.

Finally, we have the pure vitalist, teaching the same doctrine; though, with greater consistency. Thus:

"Physiology," says Bichat, "would have made much greater progress, if all those who studied it had set aside the notions which are borrowed from the accessory sciences, as they are termed. But, these sciences are not accessory; they are wholly strangers to physiology, and should be banished from it wholly." "To say that physiology is made up of the physics of animals, is to give a very absurd idea of it. As well might we say that astronomy is the physiology of the stars."—BICHAT'S *General Anatomy, &c.*

Tiedemann, too, was right in saying that,

"All the qualities of organic bodies should be looked upon as the effects of the vital powers. Even those phenomena seen in them, which they exhibit in common with inorganic bodies, undergo modifications of their specific action, and should be considered subordinate to the vital powers."—TIEDEMANN'S *Physiology, &c.*

There is not, indeed, in the whole range of medical literature, one author, however devoted to the physical and chemical views of life, who does not evince the necessity of admitting a governing *vital prin-*

ciple as a distinct entity, distinct from all other things in nature. I say, there cannot be produced one author of any consideration, who does not summon to the aid of his discussion *a vital principle* whenever he touches upon the abstract phenomena of life. And this I have abundantly shown by an extensive range of quotations in my various publications (*Except* § 1034).

165, *b*. We are constantly asked, how we know the existence of the vital properties or powers? Again, I say, precisely by the same means as the advocates of the chemical and physical philosophy of life defend their knowledge of the forces which govern the inorganic world. The question is important, as implying that physiologists either do not arrive at their knowledge of causes through their effects, or, that there is nothing different in the phenomena of organic and inorganic beings. What would the metaphysician say, were we to ask him for any other demonstration of mind than its manifestations; or the mechanical or chemical philosopher, should we demand any other evidence of gravitation, magnetism, chemical affinity, &c., than the effects which they supply? And do we not distinguish one from the other, and regard them as wholly distinct forces, by the difference in their effects? The proof is clear and tangible, in all the cases. Where the results of power differ so materially from each other, it is as good a ground of argument, that the phenomena depend upon specific powers in one case as in the other; and, if it be "a cloak of ignorance" in either case to *assume* the existence of powers, it must surely appertain to him who attempts an explanation of the phenomena by assuming forces with which such phenomena have no known connection (§ 175, *bb*, 1085).

166. Many of the eminent ancient physicians considered the vital principle an intelligent agent; and even Hunter has been supposed, though erroneously, to have been of that opinion. Some distinguished physiologists, of the present day, are inclined to regard the soul as that agent. Others confound it with the Deity;* while yet others, confounding the Deity with Nature, fall into a labyrinth of absurdities.† Others suppose the vital functions alone to constitute life.‡ The ancient physicians generally distinguished the vital principle from the soul, and regarded both as immaterial (§ 175 *d*, 350$\frac{3}{4}$ *k*).

167, *a*. The vital principle was early known under the names of *Anima* and *Calidum Innatum*. It was greatly lost sight of in the "dark ages," but reappeared among the earliest restorers of learning, when it took the name of *Anima Vegetans*, as significant of its organizing power in plants and animals. The eccentric philosopher, Paracelsus, substituted the name of *Sidereal Spirit*, to suit his dogmas of planetary and demoniac influence. Then came Van Helmont with his innovation of a *Spiritus Archæus*, an immaterial principle, which he located in the upper orifice of the stomach. It presided over the body in a general sense, and had under its command several subordinate spirits (one for each organ), to execute the orders of the great spirit. But, like Paracelsus, he expounded much of his physiological results upon chemical principles, and had no definite conceptions of the office of his Archæus. Stahl followed Van Helmont with his *Rational Soul*,

* See my article on the "Vital Powers," in *Medical and Physiological Commentaries* vol. i.; and my "*Essays on the Philosophy of Vitality.*"

† See my "*Examination of Reviews,*" p. 43. ‡ *Comm., ut supra*

and Lord Bacon had entered the field in defense of a vital principle. Then came Haller, with his great philosophical and practical distinction of the *Vis Insita* and *Vis Nervea*. Here we enter into the midst of the profound theories of irritability and sensibility, which had been suggested by Galen (§ 476, *b*). Glisson, too, had forced his way into the laws of irritability; and Baglivi had already dealt his fatal blows upon the humoral pathology. We may, therefore, date the progressive and substantial foundation of vitalism and solidism from Baglivi to Haller; a period of about one hundred years.

167, *b*. Whytt modified the Stahlian doctrine; and the visionary Des Cartes led the way in rejecting altogether, for awhile, the vital powers, in which he was aided by the hypothesis of a nervous fluid, which appeared about his time. The doctrine then followed, as a consequence, that matter acquires vitality in virtue of a peculiar organization, and this became an easy step to the atheistical doctrine of spontaneous generation. Then came up the view as set forth by Monro, Sir Humphrey Davy, and others, analogous to the Cartesian, that a living principle pervades the universe, and governs all things. Some of this school suppose the universal principle to be subordinate to the Deity; but a greater number, like Carpenter, Prichard, and especially many of our present geologists, as Lyell, &c., regard it as the Deity Himself, whereby the latter, either directly or by implication, confound nature with God. The doctrine becomes, here, either atheistical or of a direct atheistical tendency; and we have, as a renewed consequence, the assumption of spontaneous generation.*

167, *c*. Those great luminaries, Hunter and Bichat, came forward in good time to rescue the philosophy of medicine from the degradation with which it was threatened by chemistry and physics, and have left an impregnable shield to all future ages.

167, *d*. Tiedemann, too, soon after appeared with his "Physiology of Man," in which the doctrines of life are ably expounded, and which must be ranked as one of the productions of an original mind. Tiedemann could not believe that there was any sincerity in the absolute rejection of a peculiar governing principle of living beings. "However different," he says, "may be the names chosen by physiologists and physicians to designate this power, however various the ideas they attach to it, yet all must agree on the essential point, that of regarding it as intended to maintain living bodies, vegetable and animal, and all their parts, during a certain space of time, in a state of integrity, in the composition, organization, and vital properties that are peculiar to them, and to render those bodies capable, at a certain period of their existence, of producing beings of the same species as themselves, which beings are confined to the same determinate mode of formation and development, and exhibit similar phenomena." "We are bound, therefore, to consider the principle which presides over those different acts, as a power inherent in all parts of living beings, and we cannot assume that, either in vegetables or animals, it is limited to any one part or parts. All the parts of a plant, the roots, stem, branches, leaves, flowers, wood, and bark, are nourished. Nutrition takes place in all the tissues and organs of animals. The con-

* See Medical and Physiological Commentaries, vol. i., p. 25, and vol. ii., p. 124–140. Also, "Examination of Reviews," p. 43; "Notice of Reviews," p. 4; "Essays on Vitality," &c., p. 17.

tinual tendency of this power to preserve the individual and all its parts, forms the prominent character of individual life, and is presented to us *as the most important internal condition of life.* This power not only converts the alimentary matters, drawn from without, into nutritive fluids, endowed with special properties and assimilated by it, but it also introduces them into the solid organic form, determines and regulates the composition, the organization, and the vitality of parts. Every living body is exposed to external influences, which urge it to manifestations of activity. Every one, however, under certain external circumstances, retains its form, its composition, and activity. Certain external impressions, however, of a mechanical or chemical nature, and divers organic matters, vegetable and animal poisons, are able to ANNIHILATE *this power*,* and thus to cause the death of the living bodies on which they operate."

167, *e.* Next came the illustrious Müller to aid in arresting the almost universal onslaugh, in Europe, that seemed to threaten the ex tinction of every sage in medicine from Hippocrates to the exit of Bichat. Under the magic wand of Andral the venerable doctrine of humoralism reared its portentous form; while Louis substituted morbid anatomy for the science of pathology, and Liebig, and his school with fire and acids, overrun the whole domain of medicine.

Although Müller employs the language of Stahl, in relation to a vital principle, I think it rather designed as a forcible mode of expression, than as imputative of intelligence. Thus, "*this* RATIONAL *creative force*," he says, "*is exerted in every animal strictly in accordance with what the nature of each part requires.*" The fact is truly stated; but it reposes on great laws of organization, not upon intelligence That such is Müller's view appears from another expression, that, "*the formative or organizing principle is a creative power, modifying matter blindly and unconsciously.*" The radical fault of this philosopher consists, like that of Van Helmont, Stahl, Hoffmann, and Paracelsus, in referring many vital results of organic beings equally to a "vital creative principle" and to chemical forces.—See MULLER'S *Physiology.*

167, *f.* So remarkably different, however, are all the results of life from those of dead matter, that some of the shrewdest physiologists, of our own day, can scarcely avoid the chimerical theory of Van Helmont. Thus, even Marshall Hall:

"The principle of action in the cerebral system," he says, "is the ψυχη, or the immortal soul. Upon the cerebrum the soul sits enthroned, receiving the embassadors, as it were, from without, along the sentient nerves; deliberating and willing, and *sending forth its emissaries and plenipotentiaries, which convey its sovereign mandates,* along the voluntary nerves, to muscles subdued to volition."†—(HALL

* See "Examination of Reviews," p. 26–28; also, this work, § 189 *b*, 350¾ *b*.

† I have somewhere seen it suggested that the doctrines of vitalism may be applied in support of *animal magnetism.* But, while vitalism is fundamentally opposed, even to speculative theory, and rests alone on the absolute phenomena of organic beings, it is not less true that, with rare exceptions, the medical advocates of animal magnetism are, as in ancient times, among the physical theorists of life (§ 844). Dr. Elliotson is of that denomination. (See *Med. and Phys. Comm.*, vol. ii., p. 137, 138.) And, although I have, in the foregoing work (vol. i., p. 632), expressed my opinion of the countenance which has been given to this imposture by distinguished members of the medical profession, I will add my entire concurrence in the following sentiments by Hannah More. In a letter to Horace Walpole, dated 1788, she remarks, "I give you leave to be as severe as you please on the *demoniacal mummery* which has been acting in this country; it was, as usual with

on the Nervous System.) Here I suppose the "emissaries and plenipotentiaries" to be nothing more than the nervous power, a property

prodigies, the operation of fraud upon folly. In vain do we boast of the enlightened eighteenth century, and conceitedly talk as if human reason had not a manacle left about her, but that philosophy had broken down all the strong-holds of prejudice, ignorance, and superstition; and yet, at this very time, Mesmer has got a hundred thousand pounds by *animal magnetism* in Paris. Mamaduc is getting as much in London. There is a fortune teller in Westminster who is making little less. The divining rod is still considered as oracular in many places. Devils are cast out by seven ministers. Poor human reason, when wilt thou come to years of discretion!" (§ 844.)

I may also add the followiug extract from the *New York Journal of Medicine* for March, 1845:

"*New York, Feb.* 14, 1845.

"MR. EDITOR,

"Dear Sir—In a letter of the 11th inst., addressed to myself, you desire me to state what I witnessed of the firmness of a young gentleman, upon whom the operation of exsection of the inferior maxillary bone was performed by Prof. Mott, 'and the reflections to which it gave rise, as bearing on the subject of alleged surgical operations without pain in the mesmeric state.'

"The case to which you refer is briefly reported in the January number of the New York Journal of Medicine, by some person, who, like myself, was present at the operation. The subject is there stated to have been 'a fine intelligent young man, whose *heroic deportment* greatly facilitated the operation.'

"Perhaps it is enough that I should have quoted the expressive language of one, who appears to have looked on with the same admiration as myself; though these examples of 'heroic deportment' are common enough in the walks of surgery, especially among females; and that, too, without mesmeric imposture. The same eminent surgeon, who operated in the case which is the subject of these remarks, will tell you that he has extirpated many breasts, rendered highly sensitive by carcinomatous disease, without observing any evidence of pain. But there was something in the case of Mr. Baker, which certainly better deserved the encomium of 'heroic,' than any thing I had ever before seen, or heard of, or even imagined as within the compass of human fortitude.

"This case, therefore, is interesting at this moment, as evincing a perfect capability of enduring the most intense, and sudden, and prolonged pain, without emotion, and as forming a test by which 'the subject of alleged surgical operations without pain in the mesmeric state,' will receive the explanation which you seek.

"The case is also physiologically interesting, and interprets the composure of those organic movements, under similar conditions, which has been set forth in behalf of animal magnetism.

"To appreciate properly the 'heroic deportment' of young Baker, you must imagine yourself to have been a spectator; follow the able surgeon in all the capital steps, and in all the minor details of the operation, and watch attentively the 'deportment' of the subject. He was laid at a convenient elevation upon a table, his feet crossed upon each other, and his hands lapped. I mention this position, because he did not move his feet, nor displace his hands during the operation.

"Now observe the operator; first, making a long and deep incision among the muscles of the neck, and then tearing his way down to the carotid artery, and throwing and tying the ligature. It was, in itself, one of the most capital operations in surgery; but, owing to the dexterity with which it was performed, and with an operation still before us far more difficult, and tedious, and dangerous, this grand step toward the exsection of the jaw lost much of its usual interest to the spectator. But it was not the less painful to the sufferer; who, however, sustained it without betraying the slightest evidence of pain.

"Next came the circular incision, reaching all the way from the joint of the maxillary bone, down along its lower edge, up to the middle of the chin. This was done by one rapid, immense sweep of the knife; but there remained the same imperturbable composure of the patient. Not a sigh, not a groan escaped, no muscle moved—the very eye did not wink. And then followed, as you may well suppose, a prolonged, tedious, painful dissection, in which it became necessary to exasperate the suffering by securing many bleeding vessels; till, finally, the operator was ready for his saw. But nothing had yet happened to elicit a single manifestation that the patient was not in a profound slumber, excepting that his eyes were open, and that he occasionally swallowed.

"But, before sawing the bone at the middle of the chin, it was necessary to remove one of the incisor teeth, and this was so firmly rooted that a straight forceps slipped in the hand of a capable assistant. Another pull, however, brought with it the tooth; but in neither attempt was there any more indication of suffering than in drawing a nail from a board.

"Then came the process of sawing, and this was calculated to greatly annoy the patient from a slight accident which happened to the saw, and which prolonged this part of the operation. Still, however, the same 'heroic deportment' distinguished the patient forbearance of the sufferer, the same unexampled complacency continued to mark every lineament of his face, his very eye displaying nothing but gentleness, softness, and calm resignation.

of the vital principle of animals, and whose *modus operandi* in developing voluntary motion I have endeavored to expound in sections 233, 245, 500, *d*, and *references* there.

167, *g*. For the proof of the existence of a vital principle, and of the government of organic beings by laws peculiar to themselves, as derived exclusively by myself from their composition, see that division of this work, and my Essays on the Philosophy of Vitality; and for the proof which I have offered as founded on the phenomena of life, see Essay on the Vital Powers, in Medical and Physiological Commentaries, vol. i., p. 1–119.—Also, RIGHTS OF AUTHORS, p. 912.

168. It is practically useless to investigate the nature of the vital principle. That nature, however, may be as well inferred through the medium of its phenomena, as the nature of the most tangible objects. The opinion of Müller commends itself to every right-thinking mind.

"Whether the vital principle," he says, "is to be regarded as *imponderable matter*, or as a *force or energy*, is just as uncertain as the same question is in reference to several important phenomena in physics. Physiology, in this case, is not behind the other natural sciences; for the *properties of the vital principle* are as well known in the functions of the nerves, as those of light, caloric, and electricity in physics." "But, without, in the remotest degree, wishing to compare the vital and mental principles with the imponderable agents, we must express our conviction that there is nothing in the facts of natural science which argues against the possibility of the existence of an *immaterial principle independent of matter, though its powers* be manifested in organic bodies—in matter."—MÜLLER'S *Physiology*.

"The bone being separated at the chin, the dissection was resumed among the important parts, and though conducted with all possible skill and rapidity, it was necessarily tedious, as well as hopelessly painful, and, therefore, still calculated to try the firmness of the stoutest heart. A great extent of all kinds of tissues was divided, and, of course, no small proportion of nerves. Bleeding vessels continued to be secured, the difficult division of the articulating ligaments performed with as much facility as its difficulties would admit; and after the removal of the jaw, remaining portions of diseased muscle, &c., were cut away, and which tended not a little to embarrass that 'heroic deportment' which had marked every stage of this great and triumphant operation. From its beginning to its ending, which occupied one hour and a half after the first incision till the final extirpation of all the diseased mass, the sufferer did not manifest the slightest evidence of pain, or of impatience, or of fatigue, either by language, gesture, expression of countenance, winking, groaning, sighing, or any other imaginable method by which the mesmerite might be disposed to evade the overwhelming rebuke which the recital of this case cannot fail to inflict on his love of the marvelous, or his love of mischief, or his yet more culpable designs on human credulity.

"I have said that there was something physiologically interesting in the foregoing case beyond its simple merit of an 'heroic deportment,' and that it goes to the very depths of mesmeric assurance and duplicity. It was this:

"On feeling the pulse of the patient twice during the operation (the last time after the lapse of an hour), I found it calm, undisturbed, and with about the same frequency it had before the operation was begun. This proves to us what I have before expressed, that it is not pain, but the consequent mental emotions which affect the organs of circulation, whether the heart or blood-vessels.

"Thus ended an operation, unequaled in the annals of surgery; alike triumphant to the surgeon, to American Genius, to the admirable subject, to the cause of truth, of morality, and of sound religion.

"If you desire it, you may publish the foregoing statement, to which I should add some comments had I not already contributed my part, in a medical work, toward the suppression of one of the greatest nuisances that has yet infected the moral and reflecting part of the community. I have, however, some developments in reserve, which will probably see the light when the parties interested may be beyond the reach of greater reproof or mortification.

"I remain, very truly, your friend and obedient servant,

"MARTYN PAINE."

In the language of Liebig, "*In regard to the nature and essence of the vital force, we can hardly deceive ourselves, when we reflect, that it behaves, in all its manifestations,* EXACTLY *like other natural forces; that it is devoid of consciousness, or of volition, and is subject to the action of a blister*" (§ 165, *a*).

169, *a.* We know, however, but little of the nature of the principle of life, and as little of the most obvious material substances; but, while this proposition is sufficiently plain, it is extensively argued that the vital principle, or organic force, has no existence, because it is not obvious to the senses. Thus neglecting its infinite phenomena (our only knowledge of the most sensible existences), the age has run into a materialism that takes in its way the soul itself.

Our great interest lies in the phenomena of nature. Through these phenomena their causes may be sought; their nature but very imperfectly. We can only describe matter by its manifestations; and so of the soul, and the principle of life. Of the nature of the soul, however, we have, as it respects its spirituality and some other important attributes, a special Revelation.

169, *b.* If organized beings possessed a principle of life that could, like light, *be seen*, they would then be allowed to be governed by this agent, and we should be relieved of the encumbrance of the physical and chemical hypotheses. But, though no such principle address itself to the sight like electricity or light, its existence is far more variously attested by other phenomena, and more so than all the other powers of nature; and these phonomena being wholly different from such as appear in the inorganic world, it is *prima facie* evident that powers or properties which are predicated of them carry on the processes of health and disease; while the scrutiny of ages has never produced a fact in opposition.

169, *c.* Indeed, with so much light upon our subject, so much of fact to substantiate our conclusions, it would seem highly probable that all the facts which may be raised in opposition have no relative bearing, and that they are brought forward in the spirit of hypothesis.

169, *d.* The more comprehensive a law may be, the more readily is it known and determined, and the less likely is it that apparently conflicting facts will arise. Whenever such are produced, it is owing to a proper want of investigation. The facts are examined superficially; and the speculative or the credulous mind seizes upon some prominent characteristic, and pushes its opposition to nature under the spur of novelty, or the delight of discovery, or the goad of ambition. (See CORRELATION OF FORCES, p. 921, § 1085.)

Since, also, we seek, alone, for the existence and the nature of causes by means of their phenomena, he is no philosopher who refuses an inquiry into causes from want of other means of information. The objection has never been raised in any science excepting medicine; but here we are told by many that we have no means of reaching even the existence of the properties of life as contradistinguished from those of inorganic matter. It is this blindness, in part, which refuses to apply to the science of life the universal fact, that the phenomena are the only index to the forces which govern the inorganic world, that has embarrassed the progress of medicine, and encumbered it with a spurious philosophy.

169, *e.* Conscious, then, that I have taken my stand upon ground which true philosophy will recognize as her own, I shall go on with an investigation of the properties of life, as the source of all vital phenomena, of all morbid conditions, and which constitute life itself, and lie at the foundation of medicine. I shall enter far more extensively into an analysis of those properties than any other writer, shall set forth original views as to the character and office of the nervous power, and as to the mode in which this power participates in the operation of remedial and morbific agents, and endeavor to show, also, that, in proportion as philosophy may depart from the deductions which are founded on the phenomena of living beings, so must all such philosophy be fundamentally false, and become the unavoidable cause of practical errors of the highest moment (RIGHTS &c., p. 912).

169, *f.* Nor is it a small part of the proof that vitalism is founded in nature, that it is consistent throughout; seeking no multiplication of causes, but serving as an impregnable and universal foundation for every fact and every rational principle in physiology, pathology, and therapeutics; and, therefore, uniting all the principles relative to life, health, disease, and the art of medicine, into one consentaneous, harmonious whole. What a contrast with the mechanical and chemical speculations, or those commingled with vitalism! What a boundless source of stupendous philosophy for the votaries of one; what unmitigated confusion, and corruption of knowledge, and misapplication of mind, for the disciples of the other! How truly, and with what sublimity on the one hand, and imbecility on the other, is here exemplified the great distinction between man and his Creator, that the former devises in parts that may have no congruity, while the latter perfects the whole and *all together* (§ 63, &c., 74, 80, 117, 137, 143, 155, 156, 266, 323–326, 387, 399, 514 *h*, 524 *d*, 526 *d*, 638)!

170, *a.* The vital principle is a whole, in respect to its substantial nature, and is common to vegetables and animals. Organic matter, or an organized substratum, is necessary to its existence; and, since the perpetuity of organic matter depends upon the vital principle, it is manifest that both were brought into being without the agency of each other. The vital properties cannot be generated by matter, since upon them the existence of organization depends, nor is there a single phenomenon that indicates their presence in inorganic substances; nor can they be produced by the forces of physics, since they are perfectly incapable of restoring the structure, or even its elementary composition, after the organized matter is decomposed, or, of reanimating the machine before decomposition has begun; while, on the other hand, these are the forces which lay waste the structure, and only so, after the signs of the vital properties shall have totally disappeared (§ 1079 *b*, 1085).—NOTES PP p. 1142, QQ p. 1145.

This unavoidable deduction goes far in confirming the Mosaic account of the different steps observed by the Almighty in the creation of living beings; that the sensible structure was first produced, and the spiritual and vital existences superadded.* The rudiments of that organization have been perpetuated in connection with the properties of life since they came from the hands of the Creator, and are the present source of all animated beings. Any doctrine adverse to

* See *Medical and Physiological Commentaries*, vol. i., p 86–92.

this is not only atheistical, but is opposed to all the suggestions of reason* (§ 74, 350$\frac{3}{4}$ *k*). Nor is this all. The varieties in the different tissues of each animal, and of every plant, all the modifications of the vital properties in each species of animals and plants, in each tissue, and in every part, as already set forth (§ 133, &c.), and to be yet expounded, all the various functions that correspond to the modified structure and vital properties, all the secretions, even to the odor of flowers, &c., are exactly the same now as at the day they were called into being. This shows us that the properties and laws by which organic beings are governed, though infinitely varied, are as precise as the principle and laws of gravitation, as the conditions of the solar beam and the laws which they obey.—NOTE PP p. 1142.

170, *b*. Again, the moment inorganic matter is brought into a state to receive the vital principle, however low in degree or energy, it must be exalted to an organic condition. If chyle, blood, semen, the gastric juice, &c., possess life, so, also, must they possess an organic state. This, indeed, is obvious from what we have seen of the manner in which their elements are united.

170, *c*. The living principle appears, therefore, to be neither the result of organic compounds, as supposed by Hunter and others, nor, as stated by Prout, Millengen, and others, the primary cause of organic conditions. Both have coexisted since they were the product of Creative Power, both are necessary to the vivification of dead matter, and the co-operation of both to the farther development of each.

171. The vital principle appears entire in parts when separated from their connections, if such parts be constituted with the requisite structure for independent nutrition (§ 304). Hence the development of the egg, the germination of seeds and flower-buds, the growth of shoots, and the multiplication of polypi from portions of the animal.

Müller, and others, suppose the vital principle to be divisible in such cases; but this construction regards the principle too much in the light of ordinary matter, and too little in that of a specific substance endowed with a variety of properties. These properties, so far as necessary to organic life, are implanted in every part, and each part may be regarded as a whole as it respects its own organic condition. In simple beings, therefore, where no great complexity of organs is necessary to the great final cause, nutrition, many parts of such beings may be capable of carrying on the process independently of the rest (§ 299, 302, 304, 322). It is probable, therefore, that the vital principle, in the foregoing cases, is no more "divided" than the soul or instinct as implanted in the ovum.—*Medical and Physiological Commentaries*, vol. i., p. 85, 87.

172. The principle of life, or life itself, may be summarily defined as a cause, consisting of certain specific properties, appertaining to organic matter, capable of being acted upon by external and internal physical agents, by the nervous power, and by mental causes, and of thus being brought into a state of action itself, and in no other way. Its action is exerted upon the organism, and upon certain external substances, as upon food. In the former case its action gives rise to motion, upon which all the functions depend; in the latter its operation

* See *Med. and Physio. Comm.*, vol. ii., p. 123–140. Also, "*Examination of Reviews*, p. 43; and "*Notice of Reviews*," p. 2, &c., in "*Med. and Physiolog. Comm.*," vol iii. —Also, § 1079 *b*, 1085.

is through the medium of the gastric juice in animals, but is more obscure in vegetables. The principle is creative so far as it combines the elements of matter in peculiar modes, and arranges the compound molecules into tissues and organs, and in modes identical with those which came originally from the Creative Energy of God, Who thus far imparted to the principle of life a formative endowment. The principle is capable of protecting the matter which it endows against the decomposing influences of all the physical agents by which it is naturally surrounded, while the extinction of the principle exposes the organic substance to an intestine chemical dissolution, and to the decomposing action of surrounding agents, which proceeds with a rapidity without parallel in the natural state of the inorganic world. The principle is also susceptible of certain limited changes from the influence of causes, mental and physical, which constitute the essence of disease; while other causes are capable of modifying the morbid changes in such wise that the principle of life takes on a restorative energy, through which it recovers its normal condition. The properties of the vital principle are variously and naturally modified in different parts, and undergo natural modifications at certain stages of life, giving rise to changes of organization, &c. (§ 62, 64, 133, &c.). These natural modifications will be farther explained in all the detail which is demanded by one of the most important topics in physiology; and I now proceed to the various specifications relative to the principle of life.

173. It is the special province of the vital principle in plants to combine the elements of matter into organic compounds; while in animals it can only appropriate compounds of an organic nature. This is a fundamental distinction between the two departments of the organic kingdom; from which it appears that plants are indispensable to the existence of animals (§ 1052).

174. The vital principle is subject to extinction, and this constitutes death. When speaking of the composition of organic beings I adverted to the manner in which they resist the decomposing effects of chemical agents, and how the seed and egg are capable of being converted into complex living beings, or the whole animal and vegetable kingdom of being resolved into their ultimate elements, by the action of heat, air, and moisture. The same structure remains in either case when life is suddenly destroyed, and the exact difference which arises in the two cases, from the influence of the same causes, can be owing only to the presence of peculiar powers in one case which have disappeared in the other. The cessation of the phenomena of life is the consequence of death; and, there is nothing to die (certainly not the forces of chemistry) but the principle of life upon which the phenomena depended, and which held the elements of structure in vital union (§ 584, 633).

175, *a*. As set forth in the *Medical and Physiological Commentaries*, "I believe the vital principle, vital power, organic force, organic power, are one substance, whether material or immaterial; and they refer, with me, to a universal cause of animal and vegetable life, or, rather, as constituting life itself. I believe, also, that this principle has various attributes, common or generic, and partial or specific; or perhaps I should call the former distinct properties. Thus, of the generic, we have irritability, mobility, sensibility, &c., and the modifications of

each of these in the same or different tissues form the specific or partial variations. These properties are also constantly varied in disease, and these variations I call *changes in kind.* The partial modifications in their natural state I designate as *variations in kind*" (§ 133 163, 171).

175, *b.* The vital principle has certain analogies with the mind or soul, and with the instinct of animals (§ 241). Each is inherent in organic matter, and the operations of each are through the medium of that matter. Each, respectively, is one substance, and each possesses certain distinct attributes or properties. Each is not only capable of acting by means of organized structure, but of being acted upon, and modified in its nature, and only so in conjunction with that structure (§ 189, 191, 234 *f*, 241, 566–568).

Even in the inorganic world we meet with a substance which is not without its light in the way of analogy. This substance is *light* itself. It is apparently one homogeneous, imponderable, substance, yet said to consist of distinct component parts, each of which is endowed with specific attributes. These component parts would thus be distinct *entities*, which I do not recognize in relation to the properties of the vital principle, or of the soul. But the distinction is not important to my present purpose, and I should also add that it is indifferent whether we here regard the corpuscular or the more probable wave theory of light (§ 234 *e*), as the *individuality* operates in either case.

175, *bb.* It has been well said by Professor Draper, that

"Just in the same way that I am willing to admit the existence of forty different simple metals, so, upon similar evidence, I am free to admit the existence of fifty different imponderable agents, if need be. Is there any thing which should lead us to suppose that the imponderables are constituted by Nature on a plan that is elaborately simple, and the ponderables on one that is elaborately complex? That the former are all modifications of one primordial ether, and the latter intrinsically different bodies, more than a quarter of a hundred of which have been discovered during the present century?" (§ 1085).

"We are thus forced to admit that rays of light, rays of heat, *tithonic* rays, phosphoric rays, and probably many other radiant forms, have an INDEPENDENT EXISTENCE, and that they can be separated, by proper processes, from each other."—DRAPER'S *Treatise on the Forces which produce the Organization of Plants*, p. 70, 71.

Organic life, however, needs only a single principle, or "imponderable," till it be shown that its supposed properties are individual existences (§ 165, *b*).

175, *c.* I have presented in the COMMENTARIES, in the Essays "*on the Vital Powers*," and "*Spontaneous Generation*," and my "*Notice of Reviews*," certain facts which go to the conclusion that the mind or soul is a distinct immaterial substance, and that the instinctive principle of animals is equally a distinct substance from the brain. I will now add a few words, physiologically, in respect to the main argument of the materialists, drawn from analogy, that the mind, like the gastric juice, the urine, &c., is only a product of the functions of the brain (§ 1076, *c*).

The analogy is fictitious. Both the mind and instinct are entirely wanting in every known attribute of the product of other organs, and are *sui generis* in all their characteristics. This is sufficiently obvi-

ous. But there are other considerations which establish the distinction more fully, though they appear not to have engaged the attention of physiologists. What, for example, is the efficient cause of the production of bile, urine, &c.? Certainly the blood, in connection with organic structure and organic actions, and while these actions go on, bile, urine, &c., are uninterruptedly secreted; or, if arrested, it is from the failure of the organic processes. But, it is just otherwise in respect to the mind and the instinctive principle. These are completely suspended in all their manifestations during sleep, and often so with great instantaneousness. And yet there is every reason to believe that the organic functions of the brain continue to move on as perfectly as those of the liver, the kidneys, &c.; especially when it is considered that sleep may happen in almost the twinkling of an eye. Indeed, were any change to befall the brain, it should be more or less manifested by some consequent modification of all the organic actions; particularly as those of animal life undergo complete suspension.

Again, other peculiarities which contradistinguish the mind and instinct from every organic product are the quick transitions from sleeping to waking, and the occurrence of the change without any change in the organic functions of the brain. Take in connection the act of sleeping and the act of waking,—the instant suspension and the instant reproduction of the intellectual operations, and in all their isolated aspects, and the most obtuse understanding must concede not only the entire want of analogy with any other phenomena of nature, but that there must be a unique cause for such perfectly unique effects.

But, again, suppose some change in the organic condition of the brain as the cause of sleep; what is it, I say, that so instantly reinstates its functions when we pass from the sleeping to the waking state? What rouses the organ to its wonted secretion of mind? Are there any analogies supplied by the liver, the kidneys, &c. (§ 241)? What is it, I say, that brings the great nervous centre into operation in all the acts of volition, in all the acts of intellection? This question must be answered consistently, or in some conformity with the argument drawn from analogy. If that can be done, then it must be conceded that the analogy is forcible, and that the argument in favor of materialism is logically taken. So, on the other hand, should the argument fail in this indispensable requisite, materialism must stand convicted of sophistry, insincerity, and a leaning to infidelity (§ 14, *c*).

The premises are perfectly simple. They are also sound so far as it respects all organic actions and results. The blood, as with all other organs, is the natural stimulus of the brain, and here as there all the organic phenomena are distinctly pronounced. They proceed, in all parts, with uniformity, and without interruption. Nothing can suspend them or modify them in the brain, or elsewhere, during their natural condition. So far the analogy is complete. Now, as it cannot be the blood, according to the analogy, which rouses the brain to action in *willing*, *reflecting*, &c., I ask the materialist the nature of the stimulus which operates upon the brain in eliciting the phenomena of mind? And again, I say, if he can sustain his answer by analogy, such is the consistency of Nature in organic philosophy, such the harmony of Design, that it might be difficult to oppose Revelation itself to what is so fundamental in Nature. (*Continued at* p. 882, § 1076).

175, *d*. It is assumed by many late physiologists, as Drs. Carpen-

ter, Prichard, &c., after admitting and denying the existence of vital properties, and contending for their existence in the elements of matter, and the organizing agency of the forces of chemistry, that, nevertheless, all the results of organic beings are owing to the immediate acts of the Almighty (§ 64, *h*). This, therefore, as with the author of the "Vestiges of Creation," is only a circuitous method of confounding nature with God (§ 350¾ *h*–350¾ *l*). Let us, however, suppose that there is a Supreme Being in their opinion, who is the Author of nature, and that He is the Power who presides in organic beings, and regulates all their processes, and we shall see that the doctrine abounds with absurdities. Its advocates generally carry this sophistry so far as to affirm that the particles of matter are constantly maintained in union by Almighty Power, that chemical affinities are nothing but manifestations of that Power, that gravitation is only a constant emanation of the Deity, that digestion, circulation, secretion, excretion, &c., are only immediate acts of God. It is plain, therefore, that they can allow no other God than nature.

But, let us now look physiologically at this pantheism. Organic beings are made up of matter, which, it will be conceded, is distinct from God, if we allow *his* existence as distinct from matter. It is therefore perfectly consistent to suppose that this matter is endowed with distinct forces for its own government (§ 14, *c*). If we regard, next, the results of vital stimuli, we have a palpable proof that they elicit actions and physical results through principles which possess the power of acting, or we must take up the absurdity of supposing that they act on God himself. The same may be affirmed of the poisons, medicinal agents, &c. But this will not hold either in religion or philosophy. Nevertheless, it is evident that some active agent is operated upon. If stimulants are applied to the nose, the heart may be thrown, on the instant, into increased action. Of course, it cannot be entertained that God is the agent acted upon in such a case, any more than when prussic acid destroys life with the same instantaneousness; and, therefore, He cannot be assumed as the cause of the healthy and natural functions (64 *h*, 241 *d*, 350¾ *g*–350¾ *o*, 376½, 733 *d*).

In my "*Exam. of Reviews*" (in *Comm.*, vol. iii.) I have shown that the doctrine of "*the properties of life in the elements of matter*" is thoroughly material as it respects the soul (§ 14 *c*, 189 *b*, 350¾ *l*, *m*).

176. Besides an organized substratum and a principle of life, there is something still beyond not less important to all the great purposes of life. This consists of the actions and various results of life. If all animated beings existed in the state of the seed and ovum, the whole universe would be nearly without any other apparent animation than what is elicited by the forces of physics and chemistry. The movements of the heavenly bodies would be the principal demonstrative source of power.

Although, therefore, the actions and phenomena of organic beings, like the motions of the heavenly orbs, are merely the effects of a peculiar power which we call life, they are, nevertheless, the only attendants of life that interest our senses beyond the physical structure. Hence, it is not remarkable, considering how liable the senses are to take the lead of the understanding, that even the soundest minds have supposed that life consists of its results alone, and have overlooked the great efficient cause or power upon which the results

depend (§ 234 *g*, 247). Had they considered for a moment, however, the analogy which subsists between the motions of organic beings and those of the heavenly orbs, and that the latter depend upon a power which is called gravitation, and without which all the orbs would suffer the stillness of death, the conclusion would have been unavoidable that celestial motion is merely an effect, and, therefore, that all organic motions and their results depend upon moving powers. They should have seen, too, that when a drop of prussic acid, or of the spirituous extract of nux vomica, is applied to the tongue, all the phenomena of life are instantly extinguished, that nothing can reproduce them although the organized structure remains unimpaired, and that the whole being is immediately resolved into its ultimate elements (§ 1042).

177. The properties of life are the fundamental cause of all healthy and morbid phenomena. They are liable to be more or less diverted from their natural state by a variety of causes, and these new conditions constitute the most essential part of disease. This instability of the properties of life is at the foundation of all disease, and even of therapeutics (§ 642, *b*). Other causes, acting upon these morbid conditions, alter them in yet other ways, and contribute to their restoration to the natural standard. This is the aim of all our remedies; and the recuperative tendency of the properties of life (*the vis medicatrix naturæ*), when they are driven by morbific causes from their healthy state, enables them to recover spontaneously from the artificial conditions which are substituted by remedial agents for the more intensely morbid (§ 172, 851 *a*, 853, 854, 893, 900, 901, 905, 1059).

178. Notwithstanding the natural instability of the properties of life, they have a definite character in every part of the body, according to the nature of each part, at every hour of existence (§ 153–156).

179. The exact nature of disease depends mostly upon the foregoing definite conditions (§ 178), and upon the particular virtues of the morbific agents. The salutary changes produced by remedial agents involve the same principles. But, these definite changes, and the action of morbific and remedial agents, are liable to contingent influences from habits, &c.; as set forth under the fifth division of Physiology. Our calculation of results is thus embarrassed according to the nature and extent of the contingent influences (§ 756, *b*).

180. The vital properties are without renovation, or mutation in health, except as they are liable to certain natural modifications at different periods of life, or during gestation, or from the slow operation of external agents, as in the artificial temperaments. They must remain without renewal, to be forever ready for the work of nutrition, &c. (§ 237, 570–630).

181. The permanency of the vital properties enables us to understand the nature of predisposition to disease, artificial temperaments, and hereditary diseases, which many refer to the ever-changing blood (§ 238, 666).

182, *a*. According as the vital properties may be modified, either in the foregoing manner (§ 181), or as in disease (§ 177), so will be the condition of the elementary combinations, and other physical products.

182, *b*. Nevertheless, the properties of life never undergo any radical change till they shall have passed the limit of their recuperative

power (§ 177), and are therefore approaching a state of extinction. Hence, essentially, in connection with the nature of the remote causes, the analogies among diseases (§ 670, 756).

183. In their highest development, the properties of the vital principle are six; namely, *irritability*, *mobility*, *vital affinity*, *vivification*, *sensibility*, and the *nervous power* (§ 175). They are called vital properties, vital powers, and vital forces; but are clearly attributes of a common principle, just as judgment, perception, the will, &c., are properties of the soul. They will be examined according to their nearest relations to each other in the most perfect beings, and their practical application.

184, *a*. The first four properties (§ 183) are common to plants and animals, and reside in all the tissues. They may be properly called *organic* properties, as they carry on the organic processes (§ 476–492, 516 *a*). The last two are peculiar to animals. This multiplication of vital properties in the animal kingdom harmonizes with the introduction of tissues and organs which have no existence in plants (§ 201, 222, 232, 450, &c., 500).

184, *b*. The nervous power has been considered a principle by itself, and often regarded by eminent physiologists as the galvanic fluid, generated by the brain, or other organs, and conducted by the nerves (*Med. and Phys. Comm.*, vol. i., p. 65–68, 107–119). Its phenomena, however, declare it to be entirely distinct in its nature from all things else; while its analogies to the other properties of life show it to be an element of the vital principle (§ 227–232). If it be difficult for the limited comprehension of man to surmise how this property should prove an agent to others with which it is associated, the difficulty is no greater than the admitted fact that the will may control other properties of the mind, and the passions. Nevertheless, it is unimportant in a practical sense, and in the institution of principles, whether the nervous power be considered a property of the vital principle, or a principle by itself (§ 175 *bb*, 186, 226, 1072 *b*).

185. Although the organic properties which are common to plants and animals are essentially the same, they possess greater modifications throughout than will have been seen to appertain to the same properties in the different parts of animals. But all the variations in the two organic kingdoms are intimately connected by close analogies; just as they are in the different animal tissues (§ 133, &c.). Much of the difference in the general vital constitution of the two kingdoms is owing to the presence in one, and the absence in the other, of the nervous system, and those corresponding properties which play so important a part in the animal tribes (§ 733, *f*). In both departments of organic nature, however, there is, essentially, the same principle of life, its great organic elements, and the same great functions over which they preside. Here, too, in the vegetable kingdom, in the modifications of structure and of the organic properties and functions, and of the laws which they obey, we witness the greatest simplification of life. The vegetable tribes, being also exempt from most of those secondary influences which so constantly embarrass our inquiries in more complex organization, especially from the complications that arise from nervous influence, are better subjects for the experimental researches which concern the philosophy of life; and the facts, therefore, which they supply may be carried up, for the

same general purpose, as sound analogies, to more complex beings (§ 191 *a*, 409, 733, 853, 1052).

186. The mental property, perception, is necessary to the exercise of specific and common sensibility, and the will to that of mobility as modified in the function of voluntary motion (§ 194, &c., 226, 241 243, 500 *e*). Here we have not only other analogies between the intellectual and vital principles, but each is brought into direct action with the other (§ 175, 184 *b*).

187. The vital properties co-operate together in their functions, more or less, as they exist in any given being.

187½. The conditions now mentioned as to the principle of life, as well as all those to be hereafter stated, and the phenomena of which they are predicated, form other groups of facts, which, individually and collectively, contradistinguish the principle of life from all the forces of inorganic nature (§ 1041).

IRRITABILITY.

188, *a*. Irritability belongs to all tissues, and is the property upon which all vital agents, external and internal, physical and mental, natural, morbific, and remedial, produce impressions in organic life; except as sensibility is concerned in reflex nervous actions (§ 201–203, 226), and as the nerves, from being incorporated in other tissues, take a subordinate part in organic functions, independently of reflex action (§ 461, 492). All actions or motions, in animal as well as organic life, are brought about by impressions on irritability (§ 205, 233, 257, 486, 500 *d*). This may be either by the direct action of the agent, or by the indirect action of the nervous power (§ 222, &c.).

When vital agents affect the organic functions in a direct manner, it is by direct action upon the irritability of the parts which perform the functions. This is true, in part, of the natural excitants of organs; as blood acts directly upon the irritability of the heart and blood-vessels, bile upon that of the intestines, food upon that of the stomach, &c. In these cases, however, influences are also transmitted through sympathetic sensibility to the nervous centres, and thence reflected upon the muscular tissue of the organs (§ 201, 514 *f*). So, also, remedial agents operate upon the irritability of parts to which they are applied, and thus affect their functions in a direct manner. But their influences are commonly more extensive, and then they call into operation the nervous power by their action upon sensibility (§ 201), thus giving rise to reflex nervous actions (§ 222, &c., 475½, 500).

When mental emotions affect the organic functions it is by determining the nervous power upon the irritability of the parts (§ 226, 227). And, although sensibility receives the primary impressions in the function of sympathy, the resulting influences upon organic actions are brought about by a determination of the nervous power upon the irritability of the affected organs (§ 201, 226, 227, 475½, 647½, 1041).

188, *b*. When vital agents act upon specific sensibility the results of their impressions are merely their propagation to the nervous centres, and a consequent action upon those parts (§ 194–204, 222–234).

188, *c*. I shall endeavor to show that the doctrine is entirely unfounded which supposes that vital agents produce their effects in organic life by direct impressions upon the nervous system, excepting so far as explained above (§ 188 *a*). This demonstration, indeed, was made in

the *Commentaries*, but mainly by other processes than will be presented in the Institutes. The fact alone, however, should be adequate, that plants have no nervous system, yet carry on all the essential organic processes that exist in animals; while they are alike liable to corresponding results from the operation of morbific and remedial agents.

188½, *a*. Every thing which is capable of affecting irritability, and sensibility, is a vital agent. These agents are either natural to the body, as blood, heat, bile, &c., or external, as food, air, heat, light, electricity, &c. Irritability is perpetually alive to the stimulus of blood in all parts of the sanguiferous system, as it is to that of the sap wherever it circulates (§ 136). This shows the exquisite susceptibility of the property.

188½, *b*. Many vital agents, those just mentioned, are indispensable to the maintenance of organic processes, either in animals or plants. Hence, from maintaining the organic powers in constant action, they are called *vital stimuli*. Those of a morbific or remedial nature are known by these epithets, though, in a philosophical sense, they are vital agents. They are distinguished by very different characteristics from the natural agents of life; even all those which are stimulant to the organic processes; for they not only excite the properties of life, but are capable, also, of affecting their intrinsic nature. But, there are others, whose effect, in certain degrees of intensity, is directly the reverse of the foregoing, as hydrocyanic acid, tobacco, &c.; and these, when thus operating, are vital depressants (§ 441 *d*, 650, 743).

188½, *c*. Some of the vital stimuli which are natural to the body, as blood, and bile, and also food, subserve other purposes than that alone of rousing the action of organs. They are also acted upon and appropriated to the uses of the system. This is more extensively true of animals than of plants. In the latter case there are certain external stimuli which are indispensable to vegetation, and whose only operation is that of excitants, but which are comparatively unimportant to animals. These agents are particularly light and heat, and perhaps electricity. The heat which is most important to animals is generated by the living organism.

188½, *d*. An important error has prevailed among chemists, from their necessary want of physiological knowledge, in regarding the imponderable agents as the *causes* of life, and not as mere *stimuli* to those *real causes* which are implanted in the organization itself, and by which, of course, all the actions and results are determined. This vitiation of philosophy has beset, especially, the functions of animals as it regards their assumed dependence on electricity, and the functions of plants in their obvious dependence upon light. The fallacy of the former hypothesis is shown extensively in the Medical and Physiological Commentaries (*Essay on the Vital Powers and its Appendix*). Of the latter I will now say, that in all the relations of light to plants we have the most distinct analogies with other vital stimuli to guide us to the same certain conclusion, that, like other stimuli, it does but rouse the properties of life to certain special modes of action, by which they decompose carbonic acid gas, carry on the work of appropriation, &c. (*Parallel Columns*, nos. 64, 65, 66, 68, 74).*

But, thanks to my colleague, Professor DRAPER, whose name in early life glows upon the sunbeam, organic science is supplied with

* See CORRELATION OF FORCES, p. 921, § 1085.

an adornment which vies in delicacy, yet sublimity, with the capabilities of the nervous power (§ 222, &c., 234 *e*).

The professor has obligingly furnished me with the following statement of the progress, and nature, of the discoveries in relation to the solar beam. Thus:

"Until the time of Sir Isaac Newton, it was universally supposed that light was a simple elementary body, and therefore incapable of decomposition.

"The great optical discovery of Newton consisted in proving that the white light of the sun, or of day, is in reality made up of many colored varieties. He fixed the number at seven: red, orange, yellow, green, blue, indigo, violet. He indisputably established that that which we commonly call *light* is made up of, and therefore contains, the seven prismatic rays. They differ not only by impressing the organ of vision with different sensations, but also in intrinsic brilliancy or illuminating power. It is to be remarked that of these the yellow is the brightest.

"It was the opinion of Newton, and his followers, that when light falls upon bodies and disappears, it is converted into heat; or, in other words, that heat is extinguished light. Sir W. Herschel, the astronomer, proved the separate and distinct nature of these principles. The proof chiefly depends on the fact that the brightest ray is not the hottest, and that in the sunbeams there exist rays in abundance which are wholly invisible, but which can rapidly raise a thermometer. That which we cannot see we should scarcely call light. Moreover, a vessel of hot water in the darkest place is invisible; yet common observation shows it is emitting calorific emanations. The independence of light and heat may therefore be considered as established.

"Some of the alchemists discovered that certain of the white salts of silver (the chloride) turned black under the influence of the sunshine. Toward the close of the last century it was shown that the rays which produced this effect were invisible, and therefore could not be regarded as rays of light. At a later period I showed that they could not disturb a thermometer, or communicate to our organs the impression of warmth, and therefore must be distinct from heat. From the circumstance that they are always accompanied by light, I gave them the provisional name of *Tithonic* rays, from the fable of Tithonus and Aurora.

"The same species of modification which light exhibits (as colors) has been traced by Melloni for the rays of heat, and by me for the Tithonic rays. But, as both these classes of rays are invisible, their coloration must be necessarily so too, and is known to us only by indirect facts. We speak of it, therefore, as ideal or imaginary. There are seven colors for heat and the chemical rays, as there are seven for light.

"It is worth remarking how complex the constitution of light is now understood to be, when contrasted with the opinion held by the predecessors of Newton (§ 183, &c.).

"I have established, as respects some of these rays, that they discharge extraordinary functions. It is the *yellow* ray of light which has control of the evolution of plants. Under its influence their leaves effect the decomposition of carbonic acid gas in the atmosphere, setting free its oxygen and fixing its carbon. This wonderful phenom-

enon is unquestionably the first step in the production of organized matter, such as starch, woody fibre, &c., from inorganic gases. The carbon is first fixed under the form of chlorophyll in the leaf. Chlorophyll occurs under remarkable circumstances as the coloring matter of bile.

"Extended investigations have shown that each particular ray of these principles exerts specific powers. The compounds in which silver enters are affected by those of a violet color; chlorine is most acted on by the indigo; and carbon by the yellow. It is for this reason, as I have shown, that to the animal eye the yellow ray is brightest. If nature could have formed a retina of which silver was the basis, the indigo would have been the most brilliant ray. All our conceptions of beauty in colors depend, therefore, on the physical peculiarities of the carbon atom. And it is a beautiful and interesting fact, that the ray which evokes from atmospheric air the multitude of forms composing the vegetable world has charge of the process of vision in all animals (p. 797, 798, § 1034).

"Dr. Gardner discovered that the movements of plants are chiefly directed by the indigo rays of light. They grow in the direction in which it falls upon them; and the blue color of the sky is one of the causes of the upright growth of stems.

"Besides the three classes of rays which I have mentioned, there is a fourth, of which much less is known; the phosphorogenic rays. These take their name from the fact that when they fall on certain bodies, such as the diamond, Canton's phosphorus, &c., they cause them to glow with a pale or splendid light. The extraordinary peculiarity they possess is, that glass is opaque to them.

"The advance of chemical optics has sufficiently proved that each of the constituent rays of the sunbeam, or of light derived from artificial sources, has capabilities of its own. Thus, each of the seven rays of light impresses our minds with special sensations. The yellow, moreover, controls the growth of plants, the indigo their movements. Of the Tithonic rays, the blue is the one concerned in Daguerreotype portrait taking, and the red can bleach paper blacked with oxide of silver. The same peculiarities will undoubtedly be discovered as respects the rays of heat."

Professor Draper's analysis of the sunbeam, by subjecting plants to the various elements of the solar spectrum, demonstrates, what was still conjectural, the individuality of its component parts, and establishes their rank as distinct physical and vital agents. Analogy justified this demonstration; and had the professor proceeded upon the basis of analogy, and applied the spectrum to the philosophy of life, it would have been one of the most splendid achievements of the human mind. But, like Philip and Müller, in respect to the nervous power, he lost the opportunity; but in losing it, he reared another beacon upon the quicksands of chemistry (§ 476, 493, 514½ *b*).

The chemical properties of the solar spectrum having been announced by other philosophers, it only remained to infer that, like all other things, the integral parts of the spectrum which had manifested peculiar agencies in the physical world would probably, if each were specifically distinct, exhibit greater diversities in organic life (§ 52, 136, 175 *bb*). This would appear to *settle* the individuality of the numerous rays. The results of sensation, the test of the thermometer, and even

of chemistry, with their united force, established only probabilities. Nature may have supplied the unerring, the "indisputable" requisite, in the Vital Principle. And, although discovery is probably only begun, the principles of individuality, and of organic relations, are as well determined by the properties of one ray as by those of a dozen. That others than such as are known belong to the class of vital agents, there can be little doubt. The physical capabilities of other rays supply a strong analogy for this conclusion. But the doctrine of individuality is unimportant to our purpose, since, if the homogeneous nature of light and the elegant wave theory become established, each prismatic ray will be as much distinguished by peculiar properties as if every ray were an entity (§ 175 *bb*, 234 *e*).

It will be now observed that every tangible substance yields an overwhelming analogy in corroboration of the doctrine which I advance as to the vital relations of the solar spectrum; while the coincidence in the specific influences of its component parts upon organic life with every other distinct agent, equally in its own turn, surrounds the spectrum with a vital philosophy.

Nor is this alone the importance to organic philosophy of the rich discovery. The individual parts of the spectrum not only affect sensibility and irritability in modes peculiar to each, but, in beautiful harmony with all tangible substances, each part, respectively, affects certain organs only, according to their special modifications of irritability or sensibility, and according to its own peculiar virtues (§ 133 *b*, 136, 137 *b*, 150 *a*, 188 *a*, 190, 194, 199, 203). Here, also, it will be seen, is another analogical proof of the vital nature of the influences of light upon organic beings (§ 74 *a*, 303 *e*).

Much, also, may be found in Professor Draper's own conclusions to show the vital nature of the agency of light. Take, for example, the statement that the "*indigo* ray controls the movements of plants," and that "the *blue* color of the sky is one of the causes of the upright growth of plants." Now what intelligible explanation can chemistry offer of those phenomena in their undoubted relation to light? The unavoidable answer supplies an indisputable analogy for the vital influences of the *yellow* ray, &c. As to the decomposition of carbonic acid gas, it is the only phenomenon in organic life, and I may add animal, which Liebig abstracted, unequivocally, from chemical agencies (§ 350, nos. 66, 68).

If we now carry the foregoing analogies along in comparing the effects of heat and electricity with those of light upon vegetable organization, we shall readily see that a common philosophy attends the operation of the whole, and that light, in its relation to vegetable life, is nothing but a vital stimulus, adapted to the peculiarly modified vital properties of the leaf, as blood is to the sanguiferous system, sap to the circulatory system of plants, bile to the intestine, semen to the ovum, pollen to the germen, &c. (§ 133, &c.). Consider, too, the analogy which is supplied, in the foregoing aspect, by the action of light upon the retina (§ 234, *e*), and how it contributes to the production of various hues of the skin, and how, on the other hand, the skin becomes blanched, like the plant, by the exclusion of light. And the analogy may be extended to the motions produced in the iris by the action of light upon the "carbon atom" of the retina (§ 514, *k*). Nay, more, the action of light, as I have shown, by its absence, at

least, reaches far beyond the peculiarly modified sensibility of the retina (§ 199); since, by its long privation, the entire organ of vision ceases to be developed (§ 74). Again, by what chemical philosophy shall we interpret not only the painful effect of light upon an inflamed eye, but its aggravation of the disease? And here, by-the-way, its simultaneous action upon the sensibility of animal life and the irritability of organic life concur together in the demonstration.

And now to continue the analogies with electricity and galvanism. Either will promote the growth of plants which no degree or modification of light can exert. So will they, also, promote nutrition in muscles that are wasted in paralysis; and if the pneumogastric nerve be divided, the transmission of galvanism through the inferior portion will rouse the stomach to the production of the true gastric juice and partially restore digestion. And here I may stop to say, that the coincidence in the effects of galvanism upon vegetable and animal organization is one of the many facts which establish the general identity of the properties of life in both departments of the animated kingdom, while it proves that galvanism and the nervous power are perfectly distinct, though each be a vital agent (§ 73 *b*, 74, 185, 226). Again, also, galvanism is a remedial agent, affecting morbid functions after the manner of other remedies, which, with its analogy to light in promoting the growth of plants, shows farther that the latter is, in the same sense, only a peculiar stimulus to organic functions (§ 74, 303).

What is said by Professor Draper in the foregoing abstract on the subject of the yellow ray in its connection with sensation deserves a critical inquiry, not only for the sake of the facts, but as contributing light upon organic philosophy. The chemical doctrine of vision is so clearly fallacious, that any specific relations which may be shown between particular rays of light and the sensibility of the retina, may advance our knowledge, analogically, of the connection of the rays with organic functions, through irritability. But I see not how it is shown that the yellow ray "has charge of the process of vision in all animals," since "each of the seven rays of light impresses our minds with special sensations" (p. 797–798, § 1034).

Moreover, if the yellow ray give rise to sensation by its action on the carbon atom, or by any chemical influence, then, also, do each of the remaining six, and each one in modes peculiar to itself, and in all the cases upon distinct bases. Nay, more, when the retina feels the united rays, each of the seven must simultaneously exert their specific chemical actions. Besides, how are those invisible rays employed which operate chemically upon inorganic compounds? What means the important distinction between the visible and invisible rays that the former act upon organic beings, the latter upon inorganic?

From the close analogies between the relation of physical agents to sensibility in animal life and irritability in organic life, if their action in the former case be not chemical, but vital, so is it equally in the latter, and *vice versa*. It is either vital throughout, or chemical altogether.

But, organic philosophy, through its analogies, should be able to explain what chemistry cannot as to the resulting sensation when the united rays of the sunbeam fall upon the retina. One example will do it. Thus, every distinct agent of positive virtues produces distinct impressions in organic life. But, by uniting two or more together, either mechanically or chemically, a new agent is created, which op-

erates either in an individual sense, or if by several virtues, as an entire whole. So, in respect to vision, the united virtues of the numerous rays of the sunbeam acting upon the sensibility of the retina give rise to sensation attended by a white light (§ 136, 188, 193, 199, 650, 872 *a*, 1054). In organic life they equally act separately or unitedly.

The intelligent reader may now test the foregoing philosophy by what is perpetually observed within himself, and bring to its illustration the exact analogies which I have indicated as being supplied by the different passions of the mind; how anger stimulates the whole vascular system,—how fear depresses it,—how shame acts upon the capillaries of the face alone,—how joy acts upon the heart and kindles the eyes in its own peculiar way, or its antagonist, grief, seeks the lachrymal gland, or expectation of food the parotids,—how fear, again, rouses the kidneys, or bathes the skin with perspiration,—how love poises its aim at the genital organs (§ 227, 234 *g*, 509, 512, &c.). If, therefore, light do not affect organic actions, and influence organic results as supposed of the foregoing mental causes, and as imputed, also, to all vital agents, but, on the contrary, its operations upon plants, and therefore upon animals, be of a chemical nature, then, by the clearest analogy, all other agents of life, the mind and its passions, every act of intellection, every voluntary movement, belong equally to the same category (§ 175 *c*, 349 *e*, 1072).

189, *a*. Where physical views of life obtain, their advocates suppose that vital agents operate directly upon the structure. This is one of the first steps in materialism. Many of the chemical school imagine, as Liebig expresses it, that "every motion, every manifestation of force, is the result of a transformation of the structure, or of the substance of parts;" that "every thought, every mental affection, is the result of a change in the composition of the substance of the brain." And so of every pulsation of the heart (§ 350). Others, again, who belong to the school of vitalism, to accommodate their language to the physical conceptions of the day, speak of the action of vital agents "upon the structure through the medium of the vital properties." This difference among vitalists is only verbal; since, by admission, the structure can only be affected "through the medium of its vital properties," upon which, therefore, the impression must be made. Hence, distinguished vitalists, Professor Caldwell, for example, who defend the semi-physical mode of expression, often fall into the simple realities of their philosophy. Thus the professor, in his "*Outlines of a Course of Lectures*," observes that "irritability and sensibility can be acted on by stimulants alone." "Purgative medicines act chiefly on our irritability," &c. (p. 185, 187). And so it ever happens with inquirers after truth. They cannot adhere even to ambiguities of language; and others who see the truth, but build upon hypotheses, are often betrayed into fatal contradictions (§ 64, 236, 345–350, 350¾ *n*, 699 *c*, 740, 819 *b*).

189, *b*. But, what is more remarkable, the most absolute physical philosophers of life, they who deride the existence of the "vital properties," and speak of their "destruction" as an absurdity, not only fall into the language of the vitalists, but unavoidably contradict their whole system of materialism, whenever they approach the realities of life. This is true even of Dr. Carpenter, who, in his review of my *Commentaries*, attempted their overthrow by satirizing the supposed exist-

ence of "vital properties," and particularly the supposition that properties could be "*destroyed*." Thus, then, Dr. Carpenter, at a subsequent time, and in a work of great professional popularity. The capitals and italics are mine:

"It is a fact of some importance, in relation to the disputed question of the connection of muscular *irritability* with the nervous system, that when, by the application of narcotic substances to the nerves, their VITAL PROPERTIES ARE DESTROYED, the *irritability* of the muscle may remain for some time longer; and the latter must, therefore, be independent of the former. Hence we should conclude that *contractility* [*mobility*, of these Institutes, § 205] must be a property really *inherent* in muscular tissue, which MAY BE CALLED INTO ACTION *by various stimuli* APPLIED TO ITSELF, and which may be *weakened* by various *depressing agents* APPLIED TO ITSELF; and that the nerves have the power of conveying *the stimuli* which CALL THE PROPERTY INTO ACTION, but have little or no other influence ON IT."—CARPENTER'S *Human Physiology*, *Section* 376.—See, also, this work, § 175 *d*, 167 *d*, 291, 350¾ *b*; and *Examination of Reviews*, p. 8–12, 26–43.

It is important to the great objects of medicine, that I should now say, that the foregoing is only an example of numerous palpable contradictions of the physical views which form the fundamental philosophy of life in the foregoing work, and, I may add, of most others which are devoted to the propagation of medical materialism. It will be seen that enough is admitted in the preceding quotation to substantiate every doctrine advanced in these Institutes. There are the vital properties, in all their individuality, called into action by stimuli, and "acting" of themselves even beyond the doctrine of vitalists, or, again, "weakened by various depressing agents," and liable to be "destroyed;" though I do not allow, as affirmed in the quotation, that "*contractility*" is the property acted upon (§ 206). Finally, we have admitted, "that *the nerves have the power of conveying the stimuli which call the property* [*contractility, or mobility*] *into action;*" and which is all that is necessary to the whole doctrine which I have propounded as to the nervous power (§ 222–233¾, 500, &c., 512, &c., 893–905).

189, *c*. The impressions which are made on the vital properties become the causation of the changes which may ensue in the actions, or structure, of the solids, where the impression is made. No vital agents elicit actions, or a single phenomenon of life, when applied to an inorganic compound, not even from an organic being just dead from instant destruction by hydrocyanic acid, or by a pin thrust into the medulla oblongata. On the contrary, indeed, all the agents which had before contributed to the maintenance of life, now carry out the work of destruction, and more speedily resolve the organic fabric into its ultimate elements than any inorganic compound (§ 62). It follows, therefore, that agents do not elicit the actions of life by operating upon the organized structure; but upon those properties which hydrocyanic acid, &c., may extinguish in an instant of time; nor do they operate upon the functions, since those are merely effects (§ 176). And is it not a greater paradox that hydrocyanic acid, or aconite, &c., should destroy life in a second of time by its action upon the mere structure than upon that living principle which imparts to the organic kingdom all its peculiar characteristics? Or, as the blood, or joy, or anger, rouses the heart, or as fear brings on perspiration, micturition,

&c., or as the want of air throws into action the respiratory muscles, or as odors, light, &c., produce their sensations?

By facts of the foregoing nature, and by all those considerations which have been made in relation to the differences in the vital constitution of the different tissues, and of different parts of one and the same continuous tissue (as of the alimentary and pulmonary mucous membrane, § 133, &c.), it becomes perfectly obvious that the properties of life are something *per se*, something besides organization itself, or organic functions, and upon which the agents of life exert their immediate impressions (§ 1029, 1030, 1034, 1041).

There can, therefore, be no appreciation of the laws of organic beings, of the modus operandi of natural, morbific, or remedial agents, of healthy or morbid processes, of voluntary or involuntary muscular motion, of the results of the operation of the nervous power and sensibility, or even of perception, without a critical reference to the properties of life as the efficient causes, and as receiving the impressions which may be exerted by external and internal agents (§ 872).

190, *a*. Irritability, and other vital properties, are naturally modified, in kind and degree, in the different tissues, in tissues of the same order, and in different parts of one and the same continuous tissue (§ 133, &c., 199, 203, 227–232, 525–529).

These natural modifications are shown in all parts by the peculiar action of the natural stimuli of life; as blood upon the heart and blood-vessels, food on the stomach, bile on the intestines, urine on the bladder, the will, through the nervous power, upon the voluntary muscles (§ 215, 227, 486), and by the differences that arise from their action on parts to which they are not peculiar. And so of the diversified effects of external agents on different parts.

190, *b*. There are remarkable modifications of irritability in the ova of oviparous and viviparous animals, and in seeds. Semen is the only natural stimulus of the former, in their absolute state of ova; while in the ova of viviparous animals, the actions, after being roused by the stimulus of semen, must go on to a full development of the organic being, and in undisturbed connection with the parent; but, in the oviparous, when the ovum has acquired a certain development, the actions cease spontaneously, the properties of life no longer obeying the vital stimuli as in the other case. These properties then become dormant (and in the seed, also), and nature, having fulfilled her final cause, the ovum is expelled from the body, and the seed cast off, that they may be subjected to new agents. Semen will not now act upon the egg, but heat and atmospheric air become necessary to restore the actions, and carry out the process originally instituted by the specific stimulus of semen.

There are certain oviparous animals that present other peculiarities, and other changing modifications, of irritability in respect to their ova. At certain seasons their ova undergo a partial development from the influence of season, and from the stimuli supplied by the female parent. These influences, however, finally cease to operate, and the ovum is expelled to undergo the action of semen in the external world. This action again modifies irritability, and adapts it to other vital stimuli.

Again, it may be affirmed of many oviparous animals, *e. g. birds*, that a partial development of the ovum takes place, though imperfectly,

through stimuli supplied by the female parent, and the ovum is ultimately expelled as when incipient development is brought about by the stimulus of semen, but that these ova are insusceptible of renewed actions, either from the stimulus of semen, or other vital agents (§ 71–73, 1051).

191, *a*. The variations in kind and degree of irritability (§ 190) adapt each part to be acted upon by peculiar natural agents, while the same agents may have a pernicious effect on other parts, in the great plan of organic life (§ 133, &c.). The same principle governs the operation of morbific, and, more or less, of remedial agents, and is one of the main causes of disease, and of the determination of disease upon one part in preference to another (§ 149–151). The principle is, therefore, very comprehensive, and refers as well to the kind, energy, and degree of the operating causes or agents, as to the kind and degree of irritability (§ 150). And so, also, of sensibility (§ 194).

The principle is not only seen in all parts of the organic being, but every distinct species of animal and plant has, in a collective sense, its own special modification of irritability, through which its organic habits as to food, composition, nutrition, &c., are specifically regulated. It is this which renders what is poisonous to one animal or plant salubrious or inoffensive to another. And this lets us into a knowledge of the reason why certain atmospheric influences induce the "milk-sickness" in the *kine* of the Western States, and probably in no other animal. It reveals to us how it is that the stately *platanus occidentalis* and the common *peach tree* have been dying out over extensive regions of country, and why the potato-crop is cut off, year after year, in vast regions of Europe and America, while every other tree and herb escape the epidemics (§ 150). These very facts demonstrate, also, the principle as to the natural modifications of the properties of life, and establish, alone, the fundamental identity of the vital properties in the two departments of the organic kingdom (§ 185).

191, *b*. Again, more remarkable modifications of irritability, or changes in kind, are artificially effected by morbific and remedial influences, external and internal, physical and moral; and these, far more than a mere increase and depression of this property, constitute an essential part of disease. These affections of irritability give rise to new series of influences, from every variety of agent, and often very different from such as are exerted under circumstances of health (§ 542). Hence it is that ordinary food, &c., becomes morbific in diseased conditions, remedial agents operative, either for good or for evil, when otherwise they might fail of any effect (§ 226), and, upon this mutability, and varying susceptibility of the property now under consideration, is greatly founded the art of medicine. It is, especially, these varying conditions of irritability which demand so much critical reference to the exact nature of remedial agents, their doses, &c. (§ 857, 871, 878), and to the mutability of the property is particularly due the salubrious influences which are exerted (§ 901).

191, *c*. And here we have striking analogies in the manner in which the properties of the mind are modified in their character and again restored to their integrity when the organic properties of the brain become affected in the foregoing manner (§ 175).

191, *d*. Remote analogies probably exist even in the inorganic kingdom; though we have apparently nothing there in this respect

which transcends other affinities between the two great kingdoms of nature. We do not find that dead matter is endowed with properties as specifically distinct from the matter itself as the living being and the properties by which it is governed. And, so far as this analogy extends to dead matter, its properties do not appear to be liable to any mutations in kind, but only in degree; and here it would seem that the analogy should end, since we do not find that instability in the mineral world which, in the organic, grows out of the mutability of the properties of life.

What I have thus said of the analogies between the properties of living and dead matter is sustained by the late researches of chemists. Thus, on the allotropism of simple bodies, it is said by Prof. Draper, that, "to a certain extent, the views of M. Berzelius coincide with those which have offered themselves to me from the study of the properties of chlorine. They are not, however, altogether the same. M Berzelius infers that elementary bodies *can assume, under varying circumstances, different qualities.* The idea which it is attempted to communicate in this memoir is simply this,—that a given substance, such as chlorine, can pass from a state of high activity, in which it possesses all its well-known properties, to a state of complete inactivity, in which even its most energetic affinities disappear. And that, *between these extremes there are innumerable intermediate points.* Between the two views there is, therefore, this essential difference: From the former, it does not appear *what the nature of the newly-assumed properties may be;* from the latter, they must obviously be *of the same character, and differ only in intensity or degree,* diminishing from stage to stage until complete inactivity results."—DRAPER, *on Allotropism of Chlorine as Connected with the Theory of Substitutions.* 1845.

192. Irritability stands as a sentinel at all the openings and pores of the body, and between the capillary and extreme vessels of the arterial system; admitting and excluding according to its natural modifications in different parts. Thus, all but chyme is excluded from the duodenum by the pyloric orifice of the stomach, and all but atmospheric air by the glottis. The globules of blood are vastly smaller than the visible capillaries which carry only white blood, from which they are excluded by the peculiar irritability of these vessels.* When admitted, as in inflammation, it arises from a morbid alteration of irritability. And so when the lacteals absorb deleterious agents, or the pylorus allows the escape of undigested food. There is no analogy between a set of inert tubes and the living ducts. And yet are we presented with tubular instruments of glass, &c., to demonstrate the laws which govern the circulation of the blood and of sap, and sponges and lamp-wick to exemplify the process of absorption as carried on by the lymphatics and lacteals (§ 289, 291).

193. Bichat confounded irritability with sensibility, by calling the former organic sensibility, and the latter animal sensibility. He made, also, a greater mistake in supposing that irritability and sensibility are only different degrees of one property. This fact derives its importance from the high authority of the French philosopher, and the errors into which he has thus led a multitude of others.

The coincident functions between plants and animals, and organic actions being carried on in parts of animals after the greatest possible destruction of the nervous communications, evince the clearest distinc-

* A few are said to be admitted, but are visible only through the microscope.

tion between irritability and sensibility, however close their analogies in respect to the operation of physical agents. Nor can the nervous influence act as a stimulus in such cases, though the nerves may form a channel for other stimuli (§ 461, 476½ *c*, 489, 490).

2. SENSIBILITY.

194. Sensibility, which is peculiar to the vital principle of animals, resides exclusively in the nervous system. That which gives rise to true sensation is mainly limited to the cerebro-spinal system (§ 184, 523).

195. Through sensibility we learn the existence and nature of external objects. These objects make their impressions upon this property as we have seen of other agents in respect to irritability (§ 188, &c.).

Another important function is also performed by sensibility, which consists in the transmission of impressions to the cerebro-spinal axis, as a part of the great function of sympathy, or reflex nervous action.

All the modifications of sensibility are designed for the transmission of impressions from the circumference to the nervous centres (§ 450, 451). The sympathetic nerve contributes centres in organic life.

196. The nerves are the organs of sensibility, and the brain and spinal cord the recipients of impressions transmitted by this property through the medium of the nerves. Perception is also necessary to the recognized modifications of sensation; and, therefore, the perfect exercise of the power, in its function of true sensation, requires a healthy state of the foregoing elements (§ 523, no. 3).

197. Sensibility is said to be of two kinds, *common* and *specific*. I shall distinguish it into a third kind, which may be called sympathetic sensibility (§ 1037, *b*).

198. Common sensibility is the source of pain, and resides in all the nerves. It is generally dormant in the organs of organic life, but may be greatly roused by disease. The best examples of this latent state occur in the ligaments and bones. Its development by disease is a clear illustration of the light which is reflected upon natural physiological conditions by their morbid changes (§ 137, *d*).

199. Specific sensibility is peculiar to the senses, where it manifests very striking peculiarities. Light, alone, will affect the specific sensibility of the retina, the intrinsic virtues, only, of various substances give rise to tasting and smelling, certain mechanical impressions to hearing, &c. This proves a difference, or modification, of specific sensibility in the several organs of sense, by which, as in the case of irritability (§ 190, 191), it is adapted, in various parts, to the action of special stimuli, according to the predetermined uses of each part.

199½. The impressions transmitted by common and specific sensibility are received by the brain alone, or its equivalent. The spinal cord is only a medium of communication. These, also, are the kinds of sensibility which require for their operation the exercise of perception (§ 451, 523, nos. 1, 2); and it is these upon which true sensation depends. Whenever brought into operation, the mind takes cognizance of the transmitted impressions (p. 864, *note*).

200. The foregoing (§ 197–199) are coincident with what we have seen of differences in irritability (§ 133, &c., 190, 191), though more strongly pronounced, and are clear examples of what is meant by

natural modifications of the vital properties; and illustrate those modifications which constitute the essence of disease (§ 133, &c., 191).

The three principal kinds of sensibility, and the several modifications of the specific kind, as shown by the special causes which, respectively, give rise to seeing, tasting, smelling, &c., also illustrate the principle which governs the special relations of different agents, natural, morbific, and remedial, to irritability as modified in different parts; and this, also, reciprocally illustrates the characteristics of sensibility. A harmony of laws prevails universally (§ 133–138). Like irritability, sensibility is also liable to artificial modifications from the action of external and internal causes; and, as will be seen, the nervous power is susceptible of even more remarkable influences (§ 226–232, 725).

201, *a*. The last section leads me to consider the third kind of sensibility, or what I have denominated *sympathetic sensibility* (§ 197). Its office will explain the qualifying term *sympathetic*, which appears to be necessary to avoid the confusion which prevails in the application of the general term to the distinct offices of exciting acts of intellection and of influencing organic motions, and of producing involuntary motion in animal life. There was a radical objection to Bichat's designation of irritability as *organic sensibility* (§ 193); but in the present term there seems to be a peculiar advantage (§ 451, *d*).

"Impressions," says Müller, "conveyed by the sensitive nerves to the central organs are either reflected by them upon the origin of the motor nerves, without giving rise to true sensations, or are conducted to the sensorium, the seat of consciousness."

When light produces vision, or odors give rise to agreeable sensations, it is due to specific sensibility. The mind perceives, and the effect goes no farther; there is no extension of the impressions beyond the sensitive nerves. Again, the light or mechanical irritants are productive of pain, and the effect is limited in the same manner. But here there is no specific sensation. It is the same in all the organs of sense. This, therefore, is due to common sensibility. At another time, however, the light induces a paroxysm of sneezing, or the odor syncope or disease. Here is a perfectly new train of results, the principal of which are in parts distant from the direct seat of the impressions. The primary influences have been propagated upon various organs by the nervous centres through the system of motor nerves. These influences, therefore, have called into action another modification of sensibility, and that is the *sympathetic* (§ 450, &c., 464, 514 *k–m*, 902).—Note D p. 1114.

201, *b*. This variety of the common property, like specific sensibility, belongs to certain parts only of the nervous system, and is the medium through which impressions upon all parts are transmitted to the cerebro-spinal axis, in the function of sympathy. Perception, and true sensation, therefore, which is rarely an attendant phenomenon, are not necessary to the office of this modification of sensibility, nor is a continuity of the nerves with the brain. Reflected motion may be as readily excited through the spinal cord as through the brain; "and we are in possession," says Müller, "of no facts which prove that the spinal cord, when separated from the brain and medulla oblongata, can be the seat of true sensation. The reflected motions excited by the irritation of the surface in decapitated frogs are no proof of this." The ganglia of the sympathetic nerve are, also, centres.

201, *c.* Sympathetic sensibility appertains to what are denominated the sensitive nerves, and the sensitive fibres of compound nerves, which are also, in part, the instruments of common sensibility. But, a remarkable anatomical distinction, and which goes far to sustain the variety of sensibility which is here indicated, is found in the sensitive fibres of the sympathetic and pneumogastric nerves; which possess, in the most exalted degree, the power of transmitting organic impressions to the nervous centres, but which are nearly destitute of common sensibility. Indeed, it is through this system of sensitive fibres that the whole organic department maintains the specific relations of its several parts (§ 129, 523, nos. 1, 2, 3, 6, 1037, *b*).

201, *d.* The impressions transmitted through sympathetic sensibility may be received either by the brain, spinal cord, or certain parts of the ganglionic system (§ 520); and either connectedly or independently of each other. When thus received by the nervous centres, they give rise to a development and transmission of the nervous power through what are called the motor nerves, and terminate in those influences which complete the function of sympathy, by giving rise to sensible or insensible motions, or modifying such as had existed.

202, *a.* The manner in which sympathies are brought about through the medium, in part, of sensibility, and the failure of impressions upon common and specific sensibility to generate sympathy, or to excite the influence of the motor nerves, and the absence of sensation in the former case, and the admissible absence of the brain, as well as other peculiarities, prove, abundantly, the existence of this third kind of sensibility. Besides, also, the prominent demonstrations to the foregoing effect which occur in disease, this modification of sensibility is in universal operation in healthy states of the body; as manifested in respiration, and in the concerted action with which the various organs carry on their respective functions. Through this modification all parts transmit to the cerebro-spinal axis special influences that are relative to their existing conditions, and these influences are propagated through motor nerves, and maintain a harmony of movements. These reflex nervous actions are, therefore, universal and perpetual.

The special function of this kind of sensibility, and its co-operation with the nervous power in the function of sympathy, will be farther considered along with that function, and the function of motion, and again under the laws of sympathy, and the modus operandi of remedial agents (§ 1037, *b*).

202, *b.* It may be now said, however, that when sympathetic sensibility contributes to motion, whether in organic or animal life, or whether sensible or insensible, it is through impressions received and transmitted by this property to the cerebro-spinal axis, or to the centres of the sympathetic when a medium of reflex action, and a consequent development of the nervous power, which power then operates, through motor nerves, upon the organic irritability of parts which are brought into motion.

203. Like specific sensibility (§ 199), and the organic property, irritability (§ 190–192), sympathetic sensibility is variously modified in different parts, by which it is adapted to the reception of impressions from agents of particular virtues, and for their transmission to the nervous centres, and for the ultimate generation of true sympathy; while the same agents fail of these effects in other parts (§ 133, &c.).

204. Another manifest contradistinction between sympathetic, and common and specific sensibility, is seen in the general failure of impressions made on sympathetic sensibility to act upon the mind, and therefore in the ordinary absence of all sensation. If sensation be an attendant phenomenon, it then arises from impressions simultaneously made upon common sensibility (§ 445, 464–467, 473, no. 5, 474, no. 4, 523, 1037, *b*).

3. MOBILITY.

205, *a*. *Mobility* is the property by which all motions are carried on in animals and plants. It is peculiar to the solids, though some late physiologists have ascribed it to the globules of blood, while others have mistaken the globules for entozoa (§ 233, 253, &c.).

205, *b*. Sensible and insensible contractility, as employed by Bichat, and muscular power, are bad substitutes for the name mobility. They lead to erroneous conclusions; since the heart, blood-vessels, and other muscular organs dilate or elongate, as well as contract, through the same vital property; and motion occurs in various tissues.—(*Med. and Physiolog. Comm.*, vol. i., p. 150, 379–391.)

The terms sensible and insensible contractility limit the law of motion to simple contraction, while there must be often a corresponding active dilatation, or the part would always remain in a state of tonic spasm. Elasticity will never explain the dilatation of the heart, of the veins, &c.—(*Med. and Physiolog. Comm.*, vol. ii., p. 147–156, 175, 176, 399–402, where this is fully examined).

206. The philosophical Macbride remarks that, "as irritability necessarily implies mobility of the animal fibres, this does not require to be considered a distinct property." If, then, the existence of mobility be thus implied, it is a distinct property; and when the phenomena of irritability and mobility are duly considered, it will be seen that they should be regarded in a separate sense. Irritability is certainly necessary to the exercise of mobility; but the former may be greatly exalted without a corresponding increase of motion. The distinctions are numerous and of great practical importance (§ 500, *d*).

207. The existence of mobility in plants is abundantly shown by the motion of their fluids, which no mechanical principle can interpret, by their secretions, and by other results analogous to those which depend, in part, on this property in animals. It is also manifested by the sensible movements of the leaves, blossoms, stamina, &c.; and from these we may reason analogically, and infer insensible motions of the sap-vessels, the secretory apparatus, &c., as is also done in animals (§ 1054).

Mobility, therefore, gives rise to sensible and insensible motions. They are generally sensible in animal life, and of either kind in organic (§ 476–492, 516, no. 2; also, *Medical and Physiological Commentaries*, vol. ii., p. 150, 379–391).

208. Mobility is brought into operation through impressions made on irritability, whether by vital stimuli in organic life, or by the nervous power in either organic or animal life (§ 188). The philosophy of this will be considered along with the attributes of the nervous power, the function of sympathy, and the laws of sympathy.

209. If sensation apparently give rise to motion, it may be occasioned by the action of external or internal causes upon sensibility;

but this impression is imparted to irritability and then to mobility, before motion can follow (§ 195); or, from the intimate associations and analogies between irritability and sensibility, the two properties may be simultaneously affected by the same agents. Where, however, sensation is accompanied by motion as an apparent effect of impressions upon common sensibility, it probably arises in all cases from a simultaneous impression upon sympathetic sensibility (§ 198, 201, 202). This exact analysis is indispensable to our subject.

210. Irritability may be increased through an exalted state of sympathetic sensibility, and organic motions may be thus increased through sensibility; which is nearly the same as the foregoing law (§ 209).

211. It is doubtful whether parts may be irritated without exciting mobility (§ 202); but it is otherwise with common and specific sensibility, as in seeing, tasting, &c., and in pain.

212. Mobility, like irritability and sensibility, may be in a passive or dormant state, as in the ovum and seed, or as sensibility exists in the organic life of animals. All are roused by appropriate agents, and could not be roused were they not already present. Certain animals, such as the wheel, and the sloth animalcula, may have all apparent traces of life extinguished, may be completely exsiccated, and be speedily revived by heat and moisture.*

The first impression of semen, or of heat, &c., upon the ovum, or seed, is made on irritability, through which, as the next step in the process, mobility is roused into action. Then follow the new elementary combinations.

We thus learn, in part, that life is a cause, not an effect.—(*Med. and Physiolog. Comm.*, vol. i., p. 9, *et seq.*)

213. Sensible mobility is especially manifested in the compound organs, taken as a whole (§ 205). Insensible mobility occurs in the small vessels (§ 207). But, the palpable evidences of a special law of motion in the small vessels are apt to be sacrificed to the negative fact that the motion itself is not of a visible nature. As well might we deny the existence of microscopical animals.

214. The insensible motions in organic life are the most important that occur, especially such as take place in the extreme capillary vessels; since these are the instruments of all the most essential actions and phenomena of life, and of disease.

215. Voluntary motion is brought into exercise by the will and nervous power, as will be set forth under my consideration of the latter property and the function of motion (§ 222–233$\frac{3}{4}$, 500 *d*). The essential difference, therefore, between the motions in animal and organic life lies in the nature of the stimuli; voluntary motion requiring the exercise of the will, while the organs of organic life rarely obey the stimulus of the nervous power when excited by the will (§ 500 *e*). It is probable, also, that mobility has a peculiar modification in the muscular tissue of animal life.

Notwithstanding mobility, in animal life, is always subject to the nervous power, motion is here, as in organic life, independent of the nervous system, excepting as supplying a stimulus (§ 483, 486).

* See SPALLANZANI'S Experiments in *Opusculi di Fisca Animale, Opere*, t. vi, p. 482–556.

4. VITAL AFFINITY.

216. It has been seen that the elements of organic compounds are very differently combined from those of inorganic (§ 32, &c.). Hence has arisen the term *vital affinity*, as denoting a property peculiar to plants and animals, by which all their elements are united and maintained in combination. When death takes place, chemical affinities operate, and resolve the organic into inorganic compounds, or into their simple elements (§ 174).

217. Vital affinity exists in modified states in the two departments of organic nature; since, in plants, it unites the simple elements into organic compounds, while in animals, it can operate only upon compounds of this complexity. Vegetable organization is, therefore, more of a creative nature than animal (§ 13).

5. VIVIFICATION.

218. By *vivification*, in conjunction with vital affinity, life is bestowed upon dead matter. The elements of matter are, essentially, combined into organic compounds by vital affinity; but there is a progressive vitalization of the organic compounds till they become united with the solids. This shows that vital affinity must have an associate power of vivification.

219. Vivification belongs, particularly, to the assimilating organs, though its energy must be great in the gastric juice. It has natural modifications in all parts, and presents distinctions between plants and animals.

220, *a*. Vital affinity and vivification, like the other properties of life, are susceptible of morbid changes. This gives rise to changes in the general vital character, and in the composition, of the solids and fluids.

These changes in composition are inferred upon principle, as well as from observation (§ 666, *b*). No chemical analysis can detect them, unless it be an alkalescence or an acidity of the secreted fluids, or changes in the urine; and even these imperfect results are often surrounded by objections (§ 5½ *b*, 53, 1029, 1030).

220, *b*. Changes in some of the secretions, as in the milk, may be brought about by temporary influences, and independently of disease, as by emotions of the mind, the action of cathartics, &c. These also affect the condition of organs and their products in the various states of disease; and upon this depends the art of medicine (§ 852, &c.).

220, *c*, The alterations which take place in the solids and fluids are always the same in any given condition of the affected properties of life. They are, therefore, constantly liable to variations during the progress of disease, and are various in different diseases, and according, also, to the nature of remedial influences, and of those other causes by which they are affected independently of disease (§ 672).

221. The changes which arise in the solids and fluids from morbid conditions never approximate the condition of dead matter (§ 674).

221½. Changes in organic compounds may be the result of the direct action of physical agents, but are generally owing to alterative influences of direct or reflex nervous action leading to disease, and something to the natural law that the nerves impress a special condition upon animal compounds, both solid and fluid (§ 69, 226, 399, 405, 446 *a*, 455, 456 *a*, 461, 485, 488½, 489, 512, 740, 952).

6. THE NERVOUS POWER—ITS DIRECT AND REFLEX ACTION.

222, *a*. The analysis which I shall make of sympathy establishes so clearly its functional character, that I shall remove it from among the properties peculiar to animals, where it has been hitherto placed. In defining this function, generally regarded as a property, I shall introduce the nervous power, upon which, in connection with sensibility, the function depends (§ 201). This is *reflex nervous action*.

222, *b*. The philosophy of the operation of the nervous power in producing motion, under all its various aspects, as manifested in its natural regulation of organic functions (§ 202), or by its other reflex actions as induced by morbific and remedial agents, or by the influences of disease, in the motions which are generated in the organs of organic life by the passions and analogous affections of the mind, in the movements of the voluntary muscles, in the production of sudden death from all causes, as well as the solution of other relative problems, and the physiological interpretation of the recognized laws of sympathy and their general introduction into pathology and therapeutics, were originally attempted by myself in the Medical and Physiological Commentaries, and subsequently, and more extensively, in my Essay on the Modus Operandi of Remedial Agents.* Should the exposition there and now set forth prove to be well founded, it must necessarily result, sooner or later, in the overthrow of all the mechanical and chemical hypotheses in physiology, consign to its well-merited oblivion the humoral pathology, and place upon its true foundation the operation of remedial agents.—See RIGHTS, &c., p. 912.

223. The nervous power appertains to the vital principle, resides exclusively in the nervous systems, and is, therefore, peculiar to animals (§ 184, *b*). It gives rise, however, to results in organic as well as animal life. These results, also, are far more numerous and important in the organic than the animal mechanism, while sensibility is especially designed for the latter. Unlike sensibility, also, in its function of sensation, perception is not necessary to the operations of the nervous power, nor does the latter, like sensibility in its office of producing sensation, require a continuity of the nerves with the brain for reflex or direct action, especially in organic life (§ 209, 507).

The nervous power is constantly, though, for the most part, in insensible operation throughout the organic mechanism, modifying the actions and *animalizing* the products of all parts. For this special reason I have endeavored to show that the nervous power is superadded to the vital principle of animals, and that the complexity of organs and functions which it is designed to subserve, and the absence of its phenomena in plants, afford a substantial proof that the property belongs to animals alone (§ 1041.)

224. The nervous power is exerted, especially, through what are denominated the motor nerves and the motor fibres of compound nerves, or "nerves of motion;" these nerves, however, being mainly dependent for the nervous power upon the brain and spinal cord (§ 201).

Nevertheless, there is reason to suppose that the nervous power is implanted in the motor nerves, as well as in the brain and spinal cord. The phenomena of contiguous sympathy, as when inflammation of the liver, the lungs, &c., is relieved by blisters, over the region of the

* MED. AND PHYS. COMM., 1840.—ESSAY, &c., 1842.

affected organs, cannot be traced through the cerebro-spinal system, excepting in its connection with the ganglionic, which supplies, in such cases, the immediate centres of reflex nervous action (§ 893). There exists a great fundamental distinction between the cerebro-spinal and ganglionic systems, the former of which is allotted especially to animal life, the latter to organic (§ 113); and, although the cerebro-spinal be associated in function with the ganglionic, purely cerebro-spinal nerves exert no influences upon the organic functions, not even the pneumogastric till independent life begins, while the ganglionic supplies the stimulus to organic muscles, combines the organic viscera, and determines exciting and modifying effects upon all their actions, by which the secretions are variously increased or diminished, and the organic products imbued with peculiarities that distinguish them from the organic compounds of plants; and what is of vast practical importance, it is owing to those physiological differences that morbific and remedial agents operate, essentially, through the sympathetic system (§ 113, 409 *h*, 422, 461–461½, 475½, 500 *g*, 524 *a*, no. 7, 891½ *g*, *k*, 893½).

225. Like irritability, sensibility, and the other properties of life, the nervous power is capable of being acted upon by external and internal causes, both mental and physical, of being increased, or diminished, or altered in kind, according to the nature of the causes (§ 200, 203, 258).

226. The nervous power possesses the remarkable characteristic of being a vital agent to the property irritability (§ 184 *b*). It is also liable to artificial modifications from the operation of physical and mental causes upon the nervous system; and its influences upon irritability will correspond with the nature of its modifications; being thus rendered a vital stimulus, or a vital depressant, or a vital alterative (§ 150). When, therefore, this power operates in any unusual manner, organic and animal motions, whether sensible or insensible, will be variously modified, or produced, by calling mobility into exercise, according to the nature of the influences exerted upon the power, and products will vary accordingly. This grows out of the natural office of the nervous system of exciting and modifying organic actions and their results (§ 461).

227. The nervous power is brought into unusual operation very variously, according to the seat and nature of the exciting cause (§ 951).

1st. Its operation is excited in a direct manner by irritants, &c., applied to the brain, to the spinal cord, and to the motor nerves. It is also excited directly by cerebral or spinal disease, by the passions, mental emotions, imagination, intense reflection, and by the will. This I call *direct* nervous action (§ 222 *a*). In all the cases, the nervous power will be rendered stimulant, or depressant, or alterative to the organic properties and functions, and variously energetic according to the nature of the operating cause, and the intensity and suddenness with which it may operate (§ 480, 743, 951). In blushing, the power is rendered stimulant; by fear, depressant; by grief, anger, hope, &c., alterative (§ 844). These effects are also commonly very sudden, especially the physiological. Even such as are morbific are often almost instantaneous; and this rapidity of change ceases to be remarkable when we regard their near coincidence with the natural results, and that the same principle is involved in voluntary motion.

A close analogy subsists between all the foregoing direct causes and all the physical agents of life, whether natural, morbific, or remedial, as the latter may develop the nervous power through sensitive nerves. These analogies will have been variously illustrated. They

evince the simplicity of fundamental principles and the relationship and perfect harmony which prevail among the whole, even those which are especially relative to mind and instinct as superadded to the simple condition of the vegetable kingdom (§ 323–325, 818½).

2d. The reflex action of the nervous power is excited through the medium of sympathetic sensibility (§ 201–203). This complex process results in the true function of sympathy. Impressions are made by physical and mental causes, by disease, &c., upon the foregoing variety of sensibility, which I call *sympathetic* from the office of the sensitive conductors in this function of reflex nervous action. The impressions are then communicated to the cerebro-spinal axis, or to other central parts of the nervous system, and there bring into operation, and variously modify, the nervous power (§ 224). The power, thus developed, thus influenced, or so modified in kind that it partakes of the nature of the transmitted impressions, which are more or less coincident with the virtues of the remote causes, is then exerted, through the motor system of nerves, upon the organic properties of distant parts, or of the nervous system itself (§ 208, 209, 462–469), by which those properties, and their resulting functions and products, are variously affected according to the foregoing circumstances. From this fact it also results, that the modified conditions which are brought about by the nervous power, when the preternatural operation of this power depends upon external causes, whether morbific or remedial, are more or less analogous to those changes in the organic conditions which are wrought in parts by the direct operation of the same causes (§ 188, 657 *b*, 503–505, 891½ *k* 893 *e*, 902, 904 *a*, 951 *c*, 990½).

228, *a*. It thence follows, that there is imparted to the nervous power, by the foregoing means (§ 227), more or less of the characteristic virtues of the remote causes, but *under the influence of its own nature*, by which the nervous power is substituted for those causes, and thus reaches, with its acquired attributes, and their various effects, every part of the organization, and, often, with great instantaneousness. It appears, therefore, that this constitution of the nervous power is wonderfully suited to the various exigencies of life; while, as will be seen in section 232, it grows out of its physiological nature as a regulator of organic actions (§ 1057, 1075, 481 *d*).

228, *b*. It is also an important law that the nervous power is variously influenced in its morbific and remedial action by slight variations in the intensity of the operating causes, whether mental or physical; though a determination is simultaneously given to its action by the numerous other conditions already mentioned, and which may happen to be present. Thus, an impression from cold, as a blast of air, or a drop of cold water, upon the skin in syncope, will rouse the respiratory organs. Another impression from the same, and under other circumstances, will excite catarrh, or pneumonia, or articular rheumatism. One degree of impression upon the stomach by tartarized antimony will determine the nervous power upon the respiratory muscles (as will cantharides upon the bladder, or mercury upon the salivary glands), and vomiting is the consequence; while it simultaneously reflects the same power upon the skin, and other organs, and of which perspiration, &c., is a consequence. In smaller doses, the respiratory movements are not affected, but only the condition of the skin, &c., and in lesser degrees. But, these examples embrace

only certain parts of the influences in each case; while in others they are far more complex, one sympathetic result becoming the cause of others, till, through a single impression upon the skin, various circles of morbific or remedial reflex nervous actions may be instituted.

229. When disease operates in the foregoing manner in exciting the nervous power, and determining it with alterative effects upon remote parts, or upon the nervous system itself, it often imparts to it a modification by which a similar condition of disease is generated in the parts upon which the power is thus determined. Hence the consecutive inflammations which are often springing up, sympathetically, in various parts. But, this depends, more or less, upon the nature of the organs secondarily affected, upon their precise condition as diverted more or less from their healthy states by other causes, upon temperament, age, sex, &c. When, therefore, the nervous power is developed by disease, other conditions varying more or less from the primary affection are observed among the common effects. For the same reasons, also, when morbific and remedial agents operate through the medium of the nervous power, the results may be very various.

230. If the nervous power be brought into preternatural operation in a direct manner (§ 227), as when impressions are made upon the brain, or spinal cord, or the trunks of nerves, or by cerebral disease, or when the mind or passions develop its operation, it is also liable to modifications, and corresponding effects, as when the impressions are communicated through the medium of the sensitive conductors. Thus alcohol, applied to the brain or spinal cord, increases the action of the heart and capillary blood-vessels, and so do anger, joy, hope, love, imagination. But, a watery infusion of opium or of tobacco, applied in like manner, depresses those actions, and so do fear, grief, and anxiety. We see, also, various other organic functions affected in a corresponding manner (§ 480–485, 489–492, 943, 945). In these cases, the nervous power is often determined, with more or less effect, directly upon the organic properties of the brain, and may extinguish them instantly. A sudden explosion of anger may, in this manner, induce apoplexy, while in other cases the destructive influence of the nervous power is expended mainly upon the heart. Inflammation of the brain determines the nervous power directly upon the cerebral vessels which carry on the morbid process, and thus increases its force and obstinacy. So with many morbific and remedial agents of a physical nature, which, when applied to the stomach, excite the nervous power indirectly, or through the medium of the sensitive fibres of the pneumogastric and sympathetic nerves, but in which cases the nervous power is reflected upon the organic properties of the brain, or of the spinal cord, or of the individual nerves, as well as upon those of other parts. Such is the case with all the narcotics, strychnine and analogous substances, prussic acid, aconite, &c., which bear specific relations to the nervous system; either exciting or removing morbid states of the brain or nerves (§ 487 *g*, 526 *d*).

231. It is not alone the general functions of tissues and of compound organs which are affected by the nervous power in the foregoing manner (§ 227–230), but equally, also, those of the intimate organization of all parts, upon which nutrition, vital decomposition, &c., depend. It always acts upon minute structure (§ 395, 1040).

232. The modifications of the nervous power now described (§

227–230) are analogous to those which we have seen to be exerted upon irritability and sensibility (§ 191, 200), and they spring from that physiological constitution of the nervous power which is designed for great natural purposes in the animal economy. This power is manifestly associated with the vital principle of animals (§ 184, *b*) as a regulator of their multifarious parts, by which the whole are maintained in harmonious action, or by which the varying changes and failures of some shall institute vital changes in other parts that shall contribute to the restoration of the former, or exempt the general organism from the evils which would otherwise arise (§ 455). Voluntary motion (§ 215, 486), respiration, a permanent contraction of the sphincters, are also other final causes of the institution of the nervous power. The power is in perpetual operation in every part of the animal organization, though more obviously pronounced in some of its results than in others, as in the function of respiration, the permanent contraction of the sphincters, the motions of the iris, &c. It is, however, not less constantly operative, though with less intensity, in all organic processes, bestowing important conditions upon all products of an organic nature, solid or fluid, and forever stretches its universal sway, as a harmonizing power, over the whole organic mechanism. This power, therefore, is rendered exquisitely susceptible to the most astonishing variety of physical, vital, and mental causes; and, that it may feel and transmit the influences of the vital changes that may befall one part or another to other parts, for the maintenance of the great balance of functions, and to fulfill the office of restoration as well as of conservation, there is imparted to it, as to the other properties of life, a partial mutability in its nature, conformable to the various impressions exerted upon it, and by which it is rendered variously and usefully alterative to morbid conditions; and since, also, such alterative effects as are demanded by morbid states could not be exerted by a natural vital agent in its unmodified condition. Thus we have, in the obvious constitution of the nervous power, as manifest in its common functions, a principle of interpretation for all the variety of changes that are not less obviously exerted upon it by morbific and remedial agents than are plain its reflex and direct actions.

233. The nervous power does not generate motion either in animal or organic life (§ 476–492, 516, nos. 2, 7). It only influences the organic property mobility, upon which all motion depends, through the medium of irritability (§ 188, 205, 208, 209, 226). Even voluntary motion is entirely independent of the nervous system, excepting as the nervous power is a stimulus to irritability. In the production of this complex function several elements are concerned: 1st. The will, operating as a stimulus upon the brain, develops the nervous power; 2d. This power is then transmitted to the voluntary muscles, where it acts as a stimulus upon irritability (§ 226); 3d. Mobility is thus called into exercise, the immediate result of which is voluntary motion (§ 205, 206, 208, 209, 245, 256, 476 *c*, 486, 487, 492, no. 7, 500 *d*). However complex, and destitute of analogies in the world of mere physics, this phenomenon may be, I have no doubt that the solution which I have offered will be received by every philosophical mind which may attentively consider the nervous power in its connections with the motor nerves, and the experiments of Wilson Philip (§ 464, &c., 476, &c., 1041).

Since, also, the nervous power has no existence in plants, their actions are alone influenced by the physical agents of life; and, having no sympathetic relation of parts, the diseases of one part are felt by other parts only through the common laws of nutrition, while, also, remedial agents are curative by their local action alone.

233½. The nervous power, in a manner analogous to its determination upon the sphincter of the bladder after the evacuation of the urine, may be propagated upon distant parts, with morbific or curative effects, long after the removal of the agent by which it was originally excited. This is owing to the continued change, or impression, wrought upon the part to which the agent was applied (§ 514 *g*, 516, no. 6).

233¾. One of the most remarkable laws of the nervous power is that of its determination through particular nerves upon certain parts, according to the nature of the exciting cause, whether mental or physical, whether natural, morbific, or remedial, and equally so in animal and organic life; passing over, in the fulfillment of this law, various intermediate nerves of more direct anatomical connection. This is remarkably exemplified in many musical performances and feats of agility. This special determination of the nervous power is most in conformity with the special influences that may bring it into operation, in healthy conditions of the body; but in diseased states, or where organs are but partially diverted from their natural state, a direction is more or less given to the determination of the power by these acquired susceptibilities (§ 500 *j*, *k*, 871). This peculiar attribute of the nervous power distinguishes it from the direct action of remedial and morbific agents, which, if taken into the circulation in efficient quantities, would often derange the universal body. But the same physiological constitution of the nervous power which renders it obedient to the will in its transmissions to particular muscles, or to the passions in its effects on special organs in organic life, renders the power, when modified by remedial or morbific agents, and according to its precise modification and susceptibility of parts, equally determinate and circumscribed in its operation (§ 150–152, 838, 844). There is nothing in Nature more wonderful and paradoxical than this attribute of the nervous power; and while the facts which it supplies in connection with the operation of the will and the passions bear with the strongest analogical force upon the philosophy which respects the influences of morbific and remedial agents upon all parts distant from the seat of their application, that analogy is corroborated by the limitation of the morbific or remedial effects to certain parts of the organism.

233⅘. It appears, therefore, that the nervous influence, *reflex* or *direct*, is generally the *immediate remote* cause of all changes beyond the seat of the direct action of other causes (§ 644–647½, 889 *k*).

GENERAL REMARKS UPON THE PHILOSOPHY OF LIFE.

234, *a*. Notwithstanding all the laws of sympathy, that are necessary to the full interpretation of the remote effects of morbific and remedial agents, are as well established as any laws in physics, they have not been applied to these important objects; but, on the contrary, those philosophers who have contributed most to their critical exposition overlook their pathological and therapeutical bearings, and cling to the doctrines of humoralism, and of the operation of remedial agents by absorption; nor have they applied, in the least, the nervous

power in a philosophical manner to an exploration of the natural phenomena of sympathy. The oscillations of Newton, the contractions of Darwin, the vibrations of Hartley, the secretions of Galen, the galvanism of Galvani, the destructive forces of the chemist, and the caloric and the magnetism of wilder imaginations, continue to be adopted, and show as well by their great incongruity as by their failure, that the hypotheses are founded on imaginary data, and that each has neglected the phenomena of life (§ 189 *b*, 785, 1085).

234, *b*. I say nothing of those who still refuse their assent to the well-ascertained laws of sympathy, as manifested in the natural states of the body. These they have yet to study and to learn; but it may be well objected that their ignorance shall prove an obstacle to the progress of knowledge (§ 905¾).

He, indeed, must have been a very imperfect spectator of human events, who anticipates the acquiescence of ignorance or prejudice, or the ready concurrence of inferior minds, in the intricate problems which relate to the laws of the vital functions. The demonstrations of Philip have become obsolete in all but their abstract nature; and the discoveries of Prochasca, Sir Charles Bell, Müller, Hall, Valentin, and others, in the functions of the nerves, are either unknown, or unappreciated, by all but the erudite student or such as aim at erudition; and the very anatomical medium of reflex actions, through which the operations of the nervous power and the phenomena of sympathy appeal, as it were, to the *senses* as well as to the understanding, is apt to be regarded as an accidental or as a superfluous appendage of the body, or thrown in to embarrass inquiry by multiplying the complexities of organic beings (§ 1039).—RIGHTS OF AUTHORS, p. 912.

Coming to the different kinds of irritability and sensibility, or as these are modified by morbific and remedial agents, or by other physical causes, as well as the analogous modifications of the nervous power, and its remarkable attributes as a vital agent, its direct action as such when developed by causes acting directly upon the nervous system, or when brought into operation indirectly through the medium of sympathetic sensibility (§ 227), and other analogous facts which are equally substantiated by an endless variety of phenomena, they are pronounced by a no small number of the profession, even by writers who appear in the character of expounders of medical philosophy, as metaphysical speculations, or as imaginary hypotheses. Even life itself is regarded as a subtlety of the schools, or as a phantom of less reputable claims. "For my part," says Magendie, "I declare boldly that I look upon these ideas about vitality, and the rest of it, as nothing more than a cloak for ignorance and laziness"* (§ 1034).

234, *c*. If, then, you object to the existence of a principle of life, why not to the existence of mind, to the imponderables, or to tangible matter itself (§ 168, 169, 175 *bb*)? Do you deny its several well-attested properties? Then why not deny the properties of the mind? Have you not, for the aid of the senses, a tangible analogy in the solar beam (§ 188½ *d*, 234 *e*)? Do you cast aside all the phenomena of irritability and sensibility, and maintain that the action of internal and external causes, the mind and its passions, is exerted upon the structure alone, because you cannot see the properties (§ 169, 189)? Can

* See *Medical and Physiological Commentaries*, vol. i., p. 397, 511, 512, 514, 515, as to Magendie

you see the Maker of the eye, or did the eye make itself (§ 74)? Do the muscles move without a moving power? Are you not amazed at what you cannot deny, that the mutual co-operation of the mind and the brain, which results in *willing*, is limited in its action upon the body to exactly those parts where its operation can be alone useful to the animal, namely, the voluntary muscles; nay, more, that the will elects of these muscles such only as are precisely necessary to its present purpose, and bestows every imaginable degree of force within the limit of its power, and variously, also, on the several muscles which it may throw into simultaneous action (§ 233¾, 349 *e*, 500 *i*)? Is there nothing as improbable in all this as in the propositions of the vitalist? Consider how, on the other hand, those other acts of the mind, called the passions, so near akin to the will, judgment, reflection, are clearly ordained to operate in organic life for the moral and physical good of the being; or, if they be also the causes of pain and disease, the analogy of Nature shines out even here in placing them on a par with the morbific agents of the external world. If this be so, or a single fact conceded, how will you disregard the multitudinous phenomena of irritability and sensibility, or their various natural and artificial modifications (§ 64, *f*)? Will you consider an *argumentum ad hominem?* Do you, then, deny that you possess judgment, reflection, and the ability to discover truth? If you object not to this, you must concede the philosophy of these Institutes as to the foregoing properties of life, and by the same demonstration upon which that philosophy rests you must admit the imputed attributes of the nervous power, which are far more clearly and variously attested than judgment, reflection, or the ability to discover truth. Look at the experiments by Wilson Philip, Hall, Müller, Bell (§ 464, &c., 476, &c.). Look at the nervous system, and there you shall absolutely *see*. Or, do you require other aid for your *senses*, look, again, at the analogies which are supplied by the solar beam, by electricity, by galvanism, by magnetism. Consider how they astonish you in their overpowering influences upon all things but the living being. And yet you can not *see* how these destructive effects are exerted. You give up your senses when the needle traverses the compass, and stand in mute astonishment, gazing at the north for some sign that shall help the understanding as to the nature of the mysterious agent. But you *see* and *feel* nothing. Nor is this all; for the dismay of sense becomes inexpressible, when imagination surveys the interval of thousands of miles, through which the unseen force exerts its mystic sway. And so of gravitation. But the effects are strongly pronounced upon the sense of vision, and their frequent repetition begets an acknowledgment that there is something besides the tangible and visible qualities of matter which, operating through vast distances, maintains the needle in one everlasting direction, and the heavenly orbs in their undeviating rounds. And here, in the perpetual operation of magnetism, there is something to aid your conception of an equally unintermitting exercise of the nervous power (§ 1034).

234, *d*. Do you object to what I have propounded as to the artificial and temporary modifications of the nervous power (§ 227–232)? Can you state an objection, farther than that which has been just considered? Do not the infinite phenomena of sympathy mutually conspire together, without a contradictory fact, in proving the occurrence

of such modifications; and is there a single effect of morbific and remedial agents, operating through the nervous systems, which cannot be clearly, perfectly, explained by the doctrines which I have propounded in relation to the nervous power? Can a like affirmation be made of any other thing? But, you cannot *see* the modifications of the nervous power. Neither can you *see* the modifications of the electric fluid, as manifested under the conditions of electricity and galvanism; but, the effects of the latter make a strong impression upon sense, which grows into the belief that physical causes do, in reality, alter the conditions of electricity and turn it to galvanism, and those effects have actually engendered the expression of "modification of electricity." Here, then, is something for the senses, to aid them in their survey of the less tangible, but not less precise, and infinitely diversified, phenomena, that mark the artificial modifications of irritability, sensibility, and the nervous power. And, should you require a like assistance as to the natural modifications of irritability and sensibility, or even the existence of the different properties which appertain to the vital principle, you have only to regard the solar beam, and the solar prism, and try experiments with each prismatic color (§ 188½, *d*).

234, *e*. Do you marvel at the rapidity with which the nervous power moves in its operations? Consider, then, the incomprehensible velocity of light,—200,000 miles in a second of time; or the more rapid apparent motion of the electric fluid. Or, take the more probable doctrine of the undulations of light, and this will be yet more conformable to what is probably true of the nervous power. Of the undulations, then, we have not less than 458,000,000,000,000, for the red ray; 535,000,000,000,000, for the yellow ray; 727,000,000,000,000, for the violet ray, in a second of time.—NOTE EEE p. 1150.

I say, when we think of the physical effects of electricity, galvanism, magnetism, and of light, and more especially when we attempt to think of the inconceivable rapidity with which the undulations of light are propagated, we shall have no difficulty with what I have attributed to the nervous power in resolving the phenomena of sympathy, voluntary motion, &c., and when, also, we reflect that those very undulations, according to their variety, produce on the retina all the impressions that are requisite for every phenomenon of vision, and that every impression, which is thus produced, must be transmitted to the brain, before the sense of vision can be excited (§ 188½ *d*, 500 *k*).

If, also, the retina be thus sensitive to the undulations of a substance which is so imponderable that it is doubted by many whether the substratum of light be actually material, we shall have no difficulty, I say, by the aid of this plain analogy, in making the same philosophical use of the vastly more numerous and unique facts that are supplied by animal life, or in apprehending that the virtues of more substantial agents, whether morbific or remedial, may, in like manner, exert powerful impressions upon the properties of every part, both nervous and organic, and that such influences may, equally with the impressions of light, be transmitted to the brain and spinal cord, and establish impressions upon the parts in conformity with the virtues of each agent (§ 503).

The undulations of light are excited by the various objects from which they proceed. And so of the nervous power. It is not *in tran-*

situ, a movable substance, but, like the principle of light, is every where diffused through its appropriate medium, and, like that principle, is brought into operation by exciting causes. Is it difficult, however, to imagine how the nervous power can move with the velocity of light in parts so dense as the nerves? It is less difficult than the comprehension of the admitted fact that light traverses the diamond as rapidly as it does ethereal space (§ 175 *b*, 188½ *d*). Do you still marvel as to *how* the nervous power should induce or subvert diseases? Were you not equally in the dark as to the *modus operandi* of the solar beam in its various agencies upon inorganic compounds, till a few obscure phenomena led to the hypothesis of undulations? But, what have you gained by the undulations? Can you tell us how these inconceivably small motions operate, without a resort to absolute assumptions? Are you any more convinced than before, that the phenomena of light are realities, or have you been aided a whit, by these discoveries, as to your former knowledge of the laws of light? You tell us that not only the well-known colors of the solar spectrum possess, individually, specific properties, but that "each of these comprises rays differing in constitution, and differing in refrangibility, and that, doubtless, to each one specific effects are due."* You show the physiologist a few positive results, and he believes the analysis, and the existence of the several rays; though he may greatly discredit your philosophy of the effects as manifested in a department of nature which you study only under influences supplied by the laboratory (§ 188½, *d*). But, you tell him, also, that the solar ray embraces "other principles which are *invisible*," and you call upon him to admit the existence of these, notwithstanding he cannot *see* them (§ 175, *bb*). The physiologist, however, readily admits their existence upon the strength of the few facts which imply the operation of an invisible agent; and he does so because he is a physiologist. But, taking your own rule of judgment as to a vital principle and its several properties, you were doubtful whether he might demand more tangible proof; and, accordingly, you prepare him for an admission of your premises by a mode of reasoning which you reject, contemptuously, when the physiologist sets forth his endless series of facts which prove, each one, the existence of properties peculiar to living beings. You prejudge the case, as it were, by impugning his understanding, unless the induction be conceded. You tell him, that, "just in the same way that I am willing to admit the existence of forty simple metals, so, upon similar evidence, I am free to admit the existence of fifty different *imponderable* agents, if need be" (§ 175 *bb*). The physiologist requires you to admit but one, and, with this one he explains, with perfect consistency, all the processes of living beings, all the phenomena in physiology, in pathology, and therapeutics, while no one of them can be interpreted without the agency of such a principle.

234, *f*. But again, I say, what have we gained in a practical sense, or as to the modus operandi, or the laws of light and heat, or of the constituents of the solar ray, by the discovery of the undulations, or by any supposed decision of the question as to distinct rays or modifications of a common ray, or even by the prismatic colors? Nothing whatever; no more than has been gained, in a useful sense, by microscopic explorations in physiology, but with the greater advantage

* Draper's Treatise on *The Forces which produce the Organization of Plants*, p. 102.

of more precision, and more accomplishment to science, and without the pernicious hypotheses of the latter. And can the same affirmation be made of our knowledge of the properties of the vital principles, and of their natural modifications in different parts, and those which are induced by morbific and remedial agents? On the contrary, we see this knowledge every where converted to the most important uses of organic beings, not only in a direct practical sense, but in unfolding the great laws by which they are governed. This knowledge, indeed, is the great foundation of physiology and of the healing art.

Do you object to the relation which sympathetic sensibility bears to the nervous power (§ 201), and the relation of the nervous power to irritability (§ 226), in the phenomena of motion? Have you any better data for your conceptions of the relation of the magnetic pole to the needle; and to explain that relation, do you not admit a peculiar imponderable, invisible agent, which acts upon the properties of the needle? Do you understand any better, or have you any better facts respecting, the relation of physical agents to the mind, in the phenomena of sensation? You obtain your ideas of *matter* through the operation of physical agents upon the intellectual part; and how will you explain the access of those physical means to the spiritual substance unless you also admit the physiological property, sensibility? What intelligible connection is there between the properties of mind and the motions of the brain? What intelligible connection between the stimulus of the blood and the motions of the heart, or those motions which attend the generation of bile and all other organic products, unless you admit a principle of life? The forces of life are concerned about sensation in a peculiar manner, and there would be a violent interruption of the law of analogy were there not something intermediate between mind and matter, a bond of union, as it were, through which impressions upon the senses should reach the spiritual existence. We may fancy it to be electricity, or the chemical forces; but, this no more aids our comprehension, through the known phenomena supplied by these causes, as to the communications from matter to the immaterial, thinking existence, than if we regard the nerves, *per se*, as the only medium. We therefore turn our reason to the special phenomena, and find a property in universal operation throughout the body, as the medium through which certain kinds of impressions from physical agents are transmitted to the mind. But, we find, also, another analogous series of phenomena which force us to the conclusion that these depend, also, upon a certain modification of the same property as that through which impressions are made upon the mind by external objects. We see, also, that these transmitted impressions give rise to another endless series of peculiar results, which have their point of departure in the nervous centres; and we see, too, that each one corresponds with, and confirms the others, in the several series respectively. We learn, besides, that those of the last series are analogous to the direct effects of vital agents, healthy, morbific, and remedial, upon the organs which are the immediate seat of their operation. Hence, we conclude, inevitably, that there exists what is denominated the nervous power, with all the capabilities which I have ascribed to it, and that it is brought into operation through the same channel of sympathy as the mind when sensible objects exert their effects. The mind, and the nervous power, are, therefore, so far on a

par. Each is an agent, each gives rise to sensible and insensible motions, and modifies variously the ordinary results when themselves are affected in an unusual manner, and each is brought into operation by analogous causes. The mind, through the properties of life, forms a special bond of union between itself and certain parts of the organization; the nervous power, another special bond between the same properties of the vital principle and other parts of the organization, and by which, and by the perpetual operation of that power, the whole organic mechanism of animals moves on in a well-balanced, concerted action. Thus are the properties of the mind, the properties of the vital principle, and the sensible mechanism, all mutually related to each other, and bound together by laws as precise as those more simple ones which rule in the inorganic world.

234, *g*. We need not, therefore, inquire into the intrinsic nature of the nervous power, or of the organic properties. It would be as absurd as to interrogate the nature of gravitation, or of any other property of mere matter, or even matter itself; though we may well say what the nervous and organic powers *are not*, and thus save much speculation and its resulting practice. It is enough that we know their existence and the laws they obey. This is all that can be philosophically or practically useful. With these we are about as well acquainted as we are with the laws of gravitation, or of light. An ignorance of the *nature* of the principles or causes affects in no respect our study of their laws, of their modes of operating, or of the influences to which they may be liable. Their laws, like the laws of galvanism, or of optics, must remain the same, whatever theory may be adopted as to the *nature* of the causes.

Inquiries, therefore, so obviously beyond our reach as the absolute nature of the vital principle, or any of its properties, should never raise our curiosity, much less receive our attention. Their pursuit vitiates the judgment, diverts the mind from practical and useful inquiries, and renders it prone to speculation.

But again, I say, we know enough of the whole of this subject for the purposes of philosophy, and for the good of mankind, by the phenomena alone; and since the phenomena of organic beings are far more diversified than those which relate to inorganic matter, so also should we be as contented with the former as with the latter, and apply them in the same philosophical and practical manner. We also know enough of physics to marvel at nothing in organic beings which may be utterly different from the constitution, the phenomena, and the laws of inorganic matter; and, if it seem mysterious that such an agent as the nervous power should exist, with the characteristics which I have assigned, it will become less wonderful when we reflect upon the phenomena of the immaterial mind in its connection with organization, as in muscular motion, blushing, palpitation, syncope, apoplexy, &c., or even upon the velocity of light, the inconceivable rapidity of its undulations, its laws, its effects, &c.

All that we can know of the nature of any substance, material or immaterial, is by the phenomena it manifests. Where these are the same, or closely allied, as in electricity and galvanism, we may be sure that the essential causes are the same. But, where great and striking differences exist, and more especially where there are no analogies in the phenomena, as between the nervous power, or the

organic properties, and all inorganic agents, substances, or causes, we may be equally certain that the agents, substances, causes, or powers, are as different from each other, in their essence, as in their phenomena (§ 1085).

It follows, therefore, that the nervous power, and the organic properties, are, respectively, *sui generis;* having no analogies in the inorganic world.

The phenomena which different agents, powers, or causes, manifest, are so unlike each other, that different modes of investigation must be pursued to arrive at a knowledge of each; and the phenomena will be just as conclusive of the nature of one substance or power as of another. A stone, for instance, affects the sight, and touch; it appears of a certain size, shape, color, &c., or it is hard or soft; if analyzed, it is found to be composed of several distinct substances, each of which manifest other phenomena; and this is all we know of the nature of a stone. And so of magnetism, galvanism, light, heat, and whatever else appertains to the inorganic world. We examine their manifestations, and compare them together, and distinguish different things from each other by the manifestations or phenomena of each. But, there are groups of phenomena which have certain general resemblances, and these we arrange into genera or families, as the several earths, metals, gases, &c.; but the specific distinctions always remain, so that by the phenomena peculiar to each species we can always distinguish one from another. Just so it is in respect to the physical and chemical powers. The means of knowledge are of the same nature in all the cases, and the proof is as good in one case as in another.

Coming to plants and animals, a general survey of their phenomena shows us that they have no other analogies, of any importance, with the inorganic world, than in the elements of which they are composed. These are derived from the inorganic kingdom; and here the similitude ends. If we investigate the phenomena analytically, they come upon us in a profusion wholly surpassing those of inorganic beings, and without the most remote resemblance. Here, therefore, we apply the same rule as to inorganic beings, and we learn by the same process of observation as much of the nature and powers of one class of beings as of the other, and the proof is as good in one case as in the other, though more conclusive in respect to organic beings, inasmuch as their phenomena are more various. By the same rule, also, we attain all the knowledge we possess of the soul, and, beyond that of Revelation, all that is relative to a Supreme Being; and we distinguish each from all the others, or bring them into relationship, in the same way.—See CORRELATION OF FORCES, § 1085.

The same mode of reasoning is, of course, applicable to what I have said of the modifications of the nervous power (§ 227–229), and of the organic properties (§ 133–156, 188–215).

234, *h.* We are, however, so much the creatures of sense, that the majority will probably still go on explaining every thing appertaining to life by some tangible or visible cause, or by some laws with which we fancy ourselves to be better acquainted. I have already cited several examples; and if we take up any writer, indifferently, it is more than an equal chance that the authorities will be increased. Thus, here is Sir Gilbert Blane's excellent work on "Medical *Logic*."

"The changes," he says, "accomplished by the actions of life may be conceived to be effected through the agency of some imponderable fluid; such as electricity, light, or magnetism. We may conceive, for instance, that each gland may be furnished with a sort of voltaic apparatus for effecting its specific change." The same doctrine has been adopted by a host of medical philosophers of our own times. But, did any of the foregoing agents ever produce, out of the organic being, a single one of the phenomena of life? Did they ever give rise to one of those phenomena in a dead subject, although the organized structure remain unimpaired; as in cases of instant death from hydrocyanic acid, nux vomica, or from a needle thrust into the medulla oblongata? Is not the whole hypothesis contradicted by all that is known of the effects of those agents? It is the merest assumption to sustain an unintelligible and absurd hypothesis to affirm that structural derangement is necessary to death. If galvanism, the chemical forces, &c., be the immediate cause of the deposition which constitutes the interstitial growth, what bestows vitality (or life, if it be preferred) on the new-formed matter? Or, if this vitality be imparted by specific powers of the formative instruments, why should not those powers be adequate to the entire work (§ 64)? Why so great a violation of the most common rule in philosophy as to introduce other forces, whose great office is to pull down, and whose results are confusion?

234, *i*. The whole art of medicine consists in producing certain impressions upon properties or powers that are wholly unlike those which rule in the inorganic world. It will not answer to talk of modifying the operation of galvanism, magnetism, gravitation, light, chemical affinity, &c., by an emetic or cathartic. It must, however, come to this, if you will have it that those forces preside over organized beings, or even if they be allowed to have a subordinate agency (§ 175, *d*, 360, 409 *k*, 446 *a*, 488½, 493 *cc*, 500 *nn*, 893 *a*, 893½).

235. Finally, the phenomena of life are as easily comprehended as those of inorganic matter, and denote as clearly, and even more so, the nature of the causes. Who will demonstrate the nature of those physical properties by which foreign agents produce their impression on the properties of life? And yet so accurate is our discrimination among them, as prompted by the vital signs which they produce, that it is one of the most important objects of the physician to select from the multitude of cathartics, emetics, &c., a certain species whose properties shall correspond with the modified signs of the properties of life; and, it is no unusual phenomenon, that, of the whole range before him, he decides with accuracy that there is only one medicine which is well suited to the case. And his conceptions of the specific properties of the agent, and of those of the organization, even in the modified state of the latter, are so comprehensive that he may foretell their united result. He knows as much of the properties of life as of the remedial agent. He knows them far better; and that he admits their existence and specific nature is manifest from his deliberate action. Whoever prescribes for disease upon any other ground is a mere charlatan.

Who, again, will define the nature of cohesion, gravitation, chemical affinities, &c.? Like the properties of life and of spirit, and their relations to matter, their existence is only inferred from certain uniform phenomena, and from such, alone, we deduce their relations to

objects of more sensible demonstration; and this is all we know of the sensible objects themselves. We reach the connection between common matter and its properties, between the vital properties and organized structure, between the intellectual and moral faculties and the nervous system, the concurrence between them in the production of certain effects, and the differences in the nature of the several properties, by a common process of observation. There are mysteries attending the same conditions of the whole which must be left to the sole comprehension of the Author Who intended the whole to subserve the purposes in which we are alone interested; Who has wisely secured to Himself the nature and control of primary causes; and Who has thereby restricted our inquiries to the only useful end of knowledge, the existence of the causes, and their various phenomena and laws. These may be so employed as to answer the wants, the conveniences, and the various exigencies of intelligent beings. Those are the springs of action which it might be unsafe for man to understand.

236. From what I have hitherto said on the subject of life it must evidently be regarded, in a philosophical sense, as a *cause*, not as an *effect*. The functions and other phenomena are the effects. This construction, which I have also set forth in my Essay on the "Vital Powers" in other demonstrative aspects, is indispensable to any sound principles in medicine. All effects have their causes; and this simple principle obliges us to look for a *cause* of the phenomena of life. It is with the conditions of that cause, ascertained through the medium of its effects, that all physiology and medicine are concerned.

237. The powers by which living beings are governed, *cæteris paribus*, are always as precise in their operation, and bring about results as precise, as gravitation itself. But the properties of life are constantly liable to variations, and, therefore, there will be corresponding variations in their phenomena. Gravitation, and other physical forces, on the other hand, are immutable, and there are, therefore, no variations in the results of their operation. But it is also equally true that any given condition of the properties of life, connected with any given influences, is equivalent to the unvarying state of the physical forces. That particular condition, in conjunction with the supposed influences, always determines the same results, whether in health or disease. Every power in nature, when operating under given circumstances, always terminates in uniform effects. The uncertainties, therefore, to which the science of medicine is liable, or any other which has nature for its foundation, are owing to our inability to understand all the facts. If any remedial agent produce an effect at one time which it does not at another it is because the properties of life have been differently affected in the different cases; and there may have been, also, a concurrence of many other different influences. Nevertheless, in each case, the medicine operates according to established laws, and the modifications depend upon the difference of circumstances. Each combination of circumstances, however, always gives a uniform determination to the laws which govern the effects. Where the conditions are the same, the remedy in a certain dose will always produce the same results.

Although gravitation is immutable in its nature, we yet see something analogous to the foregoing influences upon the properties of

life in the manner in which the revolution of the heavenly bodies may be affected by their interference, in relation to each other, with the power as exercised by the sun; as seen in the erratic movement of comets. In either case the incidental influences may be calculated, and the results foretold,—conforming, in one case, to the laws of gravitation, and in the other to those of the vital force. The sameness of the physiological conditions enables us to calculate not only what will happen to-day, but through all future time. But, the vital conditions are subject to precise modifications at the several great eras or stages of life; but, being marked by uniformity, the results are forever the same, at each era respectively. The fundamental changes enable us, also, to foresee how the modified properties of life will be differently affected by vital stimuli, the new sympathies that will spring up, the different relations of sensibility to the faculties of the mind, the difference in the acquisition of knowledge, &c., at the several eras. From these natural and uniform modifications of the vital states, we may turn to those of a fluctuating and accidental nature, which grow out of the influence of climate, habits, employments, &c., and which may be not only as lasting as the individual, but may be transmitted to his posterity. As at the different eras of life, we here find, also, variable influences from the natural, the morbific, and the remedial agents, variable sympathies, &c., among organs, according to the artificially-modified condition of the properties of life. These conditions, however, are rarely exactly the same in any two individuals; but, they are strictly analogous in principle to the natural ones which distinguish the several stages of life, and, so far as they may be known in any given case, we may calculate, with great approximation to the truth, what will be the special characteristic phenomena that will mark the organic, the animal, and the intellectual existence of that individual (§ 153–156, 535, &c., 574, &c.).

Thus we have a series of analogies, in respect to the mutability of the properties of life, and corresponding results, which bring us upon the confines of disease; which consists, also, in certain modifications of the vital properties, but more profound, more various, and more transient (§ 176–182). Here lie the difficulties of medicine; difficulties attending our knowledge of the modifying causes, the influences they produce, the complications of sympathy, and other contingent circumstances. All these conditions must be known in any given case, to foresee, with certainty, any immediate or more remote result either of disease or of the action of any medicine, or of any natural vital agent. But, the properties of life being never very greatly varied from their natural character, we may come, by a careful observation of their varying phenomena, to a knowledge of their conditions, and to foresee the results, or such as may spring from the operation of medicine, from the different kinds of food, &c., with sufficient accuracy for all useful purposes. With this knowledge, we get at the most important laws of disease, general and specific, and build up principles which are more valuable in practice than ages of disconnected experience (§ 149, 150).

238. I have said, that although instability is a prominent characteristic of the properties of life, and lies at the foundation of disease and therapeutics, these properties never undergo any radical change till they shall have lost their recuperative tendency. They are the only

attributes of organic beings that do not undergo absolute change and renewal. These properties must be forever present, without essential change of their nature, to carry on the work of decay and renewal, which are in perpetual progress in all the solids and fluids over which the properties preside.

Hence an important law, that all hereditary predispositions to dis ease, and all impressions from morbific agents, which do not produce their manifest effects till the blood shall have undergone a renewal (as in hydrophobia, fevers, &c.), must be primarily exerted upon the properties of life, and that all the subsequent changes in the fluids and solids must be due to that original modification of the vital properties. To perpetuate the primary influences something of a permanent nature must receive the impression. Analogy, alone, would assure us that this must be also equally true of the effects of all morbific and remedial agents (§ 666).

239. There is nothing more important to be known and appreciated than the endowment of the properties of life with a tendency to return from diseased to their natural states. This is the *vis medicatrix naturæ*, and is the immediate foundation of therapeutics. This, and this alone, has given rise to the art of medicine; since, by no artificial means can the diseased properties and functions of life be converted into their healthy state. It is also remarkable that the most efficient remedial agents institute their favorable effects by establishing new pathological conditions; which farther shows that it is nature alone which cures, and through the foregoing principle. That principle consists in the controlling influence of physiological laws, and, without it, organic nature would become extinct (§ 853).

240. Connected with the foregoing law is another not less fundamental, and which shows the fallacy of reasoning from the effects of remedial agents upon healthy to morbid conditions. It is, that the susceptibility of all parts to the action of remedies, physical or mental, is very different in disease from what it is in health, and the nature and the results of the influences are greatly different in the two conditions. Take many of the most powerful agents, arsenic, tartarized antimony, iodine, &c., and when administered in certain small and repeated alterative doses they bring about the cure of the most obstinate and formidable conditions of disease; while the same doses may not manifest any action upon the system, or on any part of it, under circumstances of health. This manifestly depends upon an increased susceptibility of the organic properties, in their diseased conditions, to the action of foreign agents, and upon an increased disposition to undergo changes. And here we have opened a grand display of infinite Design, Wisdom, and Goodness, to mitigate the penalties of disease, and to preserve the human race. This law, which unfolds a principle latent in health, and by which morbid organic properties acquire susceptibilities to salutary influences from agents which in health would either produce no effects, or lead to untoward results, and its ally, the great recuperative principle (§ 239), impose the highest obligation on physicians to become medical philosophers.

7. THE MIND AND ITS PROPERTIES.

241, *a*. Reason and instinct belong to man; instinct alone to animals. Mind is commonly regarded as synonymous with reason, and

instinct a principle by itself. The latter is undoubtedly true of animals; but I would consider instinct, in relation to man, as a property of the soul; while in animals it is shorn of the great distinguishing attribute of man, the rational, immortal faculty. Independently of the specific facts which go to this conclusion, it has the strong ground of analogy in the more complex condition of the principle of life as it exists in animals than in plants (§ 184, 185).

241, *b*. To simplify the discussion of this intricate subject, the word *mind*, with the foregoing explanation, and *mental properties*, so far as perception, the will, and the understanding, are concerned, may be applied indiscriminately to man and animals. Judgment and reflection are the great characteristics of reason; but, contrary to the usual representation, the understanding belongs as well to the instinct of animals as to the human mind. Many, again, may be disposed to consider the understanding a function, rather than a property; but this construction would suppose the operation of judgment and reflection, which do not belong to animals. The term is also employed in other acceptations than the present.

241, *c*. The abstract manner in which metaphysicians have considered all the operations of the mind, while no one of them is performed without the co-operation of the brain, or a principal nervous centre, and originally elicited through the corporeal senses, proves to us that physiologists are best qualified to analyze the phenomena of the soul and of instinct, and to indicate their relations to the body, and the laws which they observe. There is also a mysterious affinity between the soul of man and the instinct of animals, of which metaphysicians take but little or no cognizance. This alliance is shown by the corresponding manifestations of perception, of understanding, and of the will in animals; by the amazing precision with which their habits are regulated; by the evidence of common passions; by the coincidence in the external senses of man and animals, through which they alike acquire a knowledge of external things; by the parallel in the anatomical structure of the brain of man and of animals which stand high in the scale; and by other analogies, which denote an affinity between the soul and instinct So great and various, indeed, are the evidences of the foregoing nature, that the special attributes of instinct are associated with the human mind; thus forming a connecting link, through the moral faculties, between rational and irrational beings.

Nevertheless, the phenomena of the human mind are infinitely superior to those of instinct, while the operations of instinct in animals greatly surpass any of its manifestations in man. Many special peculiarities concur, also, in demonstrating an absolute distinction between the rational mind and instinct. The latter, for instance, always moves, in each individual species of animal, in a particular, unvarying path, but differently in each species of animal.* It never diverges to improve its original endowments, or to add a gain which it did not possess in its infant condition. It is then nearly as perfect in its operations as at mature age; nor does one generation of animals gain upon its predecessors. How different with reason, and with the instinct of man! He passes through early infancy without a trace of the former, and with only that helpless development of the latter which ena-

* Here I may say *that analogy proves that there is but one species of mankind, since the manifestations of reason and instinct are the same in all.*

bles him, with the foreign aid of reason, to imbibe the sustenance required by organic life. Unlike the instinct of animals, however, the corresponding manifestations become greatly multiplied as age advances; but it remains always far more circumscribed and imperfect, and often plunging itself, and leading reason, into violations of their natural functions. And what a contrast between the limitations of instinct and the progress and grasp of the human mind; the latter forever ranging through all the labyrinths of nature, investigating their phenomena, developing their powers, their subsidiary causes, and their laws, turning in upon itself and multiplying its knowledge, and enlarging its powers by its own independent efforts, laying up the gains of the past as a fruitful source of present good and of farther acquisitions, distinguishing good from evil, from which results the sense of moral responsibility, investigating its own attributes, and attempting even its own nature, and tracing up its existence to a Higher Power, as the Author of the Universe which was made for the contemplation and the enjoyment of mind (§ 175 *c*).

241, *d*. It is not an object, however, of the Institutes to investigate the philosophy of mind beyond those physiological considerations which are relative to the properties and functions of life, however it may have been important to their interests to contradistinguish the Maker from His works (§ 14 *c*, 175, 350$\frac{3}{4}$ *h–l*). *Perception* and the *will* are the only mental properties which concur, more or less, in the phenomena of animal life.

242. *Perception* is always necessary to true sensation, and therefore to the exercise of all the senses. The mind, or instinct, must perceive an impression made upon sense, and consciousness must operate before the impression can be realized. The phenomena of sympathy in their connection with sensibility, in the ordinary processes of life, are not relative to sensation, but depend on a special modification of sensibility and on the nervous power.

243. The *will*, another property of the mind, upon which volition depends,*exemplifies yet farther the complexity of the principles which obtain in the animal kingdom; and its phenomena admonish us to pause over that materialism which sees nothing but the demonstrations of physical and chemical power in the equally unique manifestations of irritability, sensibility, mobility, the nervous power,—the entire organic force (§ 215).

The will presides in animal life. It governs the movements not only of the voluntary muscles, but even the operations of the other mental faculties. In producing muscular motion, the operations of judgment and perception are often associated, and even bring the will into action. All muscular movements with which the mind, or instinct, is not connected, depend upon other causes than the will. Voluntary motion is, therefore, as dependent on the will as true sensation is upon perception (§ 1072, *b*).

The will has very little operation in organic life (§ 500, *e*); though the passions operate with power upon the heart, the abdominal viscera, &c. This peculiarity is founded in consummate Design; since greater latitude to the will would be incompatible with animal existence; while, on the other hand, other elements of the mind are allowed, for useful purposes, to stretch their influences to the deep recesses of life.

244. The will, a property of the mind, like the nervous power a

* By some the *will* is considered as a result of the concurrent action of the mental faculties. But this is unimportant. See my work on the SOUL AND INSTINCT, 1870.

property of the vital principle, is, therefore, a vital stimulus to the brain, whose chief office is the production of voluntary motion, by bringing into action the nervous power.

245. When the will gives rise to voluntary motion the philosophy is the same as when motion is developed in the organs of organic life by the nervous power (§ 205–215). The latter may take place through impressions transmitted to the nervous centres (§ 227, 500), or by impressions exerted in a direct manner upon these centres (§ 227, 230, 477). The will operates in the direct manner, develops the nervous power, and transmits it to the irritability of the voluntary muscles, by which mobility is brought into operation (§ 233). When the passions affect the movements in organic life it is exactly in the same way as with the will in animal life (§ 500 *h*, 1040, 1072 *b*).

246. Thus it appears that the unity in the great plan of the nervous power, in its relations to both organic and animal life, to mind as well as to matter, and the perfect concurrence of all the facts, and the obvious nature of the whole, which declare a harmony of principles and laws throughout all the immense variety relative to the nervous power, continue to unfold a grandeur of the subject which invites an unprejudiced attention to the expositions I have made of this brilliant institution of Nature (§ 1069–1082).

FOURTH DIVISION OF PHYSIOLOGY.

FUNCTIONS.

247. Our fourth grand division of Physiology comprehends the functions of organic beings. They are carried on by the properties of life in their connection with organized structure (§ 170, 175, 177), and of which the functions are the great final causes, or effects (§ 176). They are, indeed, the only useful ends of life; since, otherwise, all organic beings would exist in the condition of the seed and egg (§ 235, 236). The terminating series of the capillary vessels are the immediate instruments of all the essential processes in organic life, and therefore, also, of all diseases (§ 109, 410, 411, 668, 679).

248. The functions are *common* and *peculiar*.

249. The common functions belong to all organic beings. They consist of, 1st. *Motion;* 2d. *Absorption;* 3d. *Assimilation;* 4th. *Distribution;* 5th. *Appropriation*, or nutrition and secretion; 6th. *Excretion;* 7th. *Calorification;* 8th. *Generation.* The first seven are indispensable to animals and plants. The eighth appertains only to the species, and has no essential part in the organic economy (§ 97, 118–123, 153–156, 237, 578).

250. The peculiar functions belong to animals only. They are,

I. Functions of relation; comprehending, 1st. Sensation; 2d. Sympathy, or reflex nervous action.

II. Voluntary motion, and functions by which the mind and instinct act on external objects.

III. Other mental and instinctive functions.

I. COMMON, OR ORGANIC FUNCTIONS.

251. Organs which perform similar functions are very variable in structure in different orders of animals. The liver, for example, "is represented in one case by simple cæca, or blind sacs; in another by tufts of cæca; in a third by bunches of cells; in a fourth by a spongy mass; in a fifth by branched ducts ending in feather-like terminal twigs;" and so on, up to the complication of the most perfect animals. Nevertheless, they all secrete a very analogous fluid. And so of other organs and functions.

A due regard for the preceding facts must unavoidably reconcile every mind to what I have said as to microscopical explorations of the minuteness of structure (§ 131, 304, 306, 409, *e*).

252. Though structure be very various, there is a great analogy in the vital functions and their immediate products,—even between plants and animals. This is remarkably true of every individual part in the different races of animals, whatever its simplicity or complexity (§ 251). Hence, it becomes more and more manifest that the properties of life have a greater agency in the formation of organic products than the structure itself (§ 67–69).

1. MOTION.

253. Motion is the immediate result of the action of mobility or contractility, and was necessarily explained in describing that property (§ 205–215). It is the function by which all things acquire their movement in organic beings.

254. Motion may be remotely mechanical, as the movement of the blood, ingesta, &c.; but the power and the actions of parts which generate the mechanical movements are purely vital.

255. Motion belongs, of course, to every tissue in which its manifestations occur; and it is therefore an error, however common, to limit this function to the muscular tissue.

256. The great offices of motion in organic life are to supply the system with useful materials, and to remove such as are useless.

257. In animal life this function appears under the aspect of locomotion or some analogous result, and I have associated the consideration of this modification of the function with that which is common to the organic life of animals and plants, on account of their common nature.

258. Voluntary motion proceeds from the action of the will upon the great nervous centre, by which the nervous power is developed and transmitted to the irritability of the voluntary muscles (§ 188, 208, 233, 476 *c*). Here the excitation of the nervous power is direct, as in the experiments by Wilson Philip (§ 486, 487). If the motion be involuntary, as in the ordinary movements of respiration, the development of the nervous power is indirect, according to the usual process when organic actions are influenced by the nervous power (§ 222, &c., 500). When other involuntary motions affect the muscles of animal life, as convulsions, &c., the development of the nervous power may be direct, as in diseases, and concussions, of the brain, or indirect, as in teething, and intestinal irritation. The philosophy, however, respecting the production of motion in all these cases, is exactly the same. Whether the movements be voluntary or involuntary, the

movements depend upon the action of the nervous influence upon mobility through the property irritability. The mind does not, as has been supposed, leave the brain to enter the muscles in voluntary motion. The difficulties of explanation are not only multiplied by this supposition, but it is shown to be erroneous by the analogous movements which may be excited through the spinal cord, or through the nerves, after the soul and instinctive principle are separated from the body by the removal of the head. This philosophy is also coincident with that which I have propounded as to influences of the nervous power in organic life. Each illustrates and sustains the other (§ 500).

259. It is now important to repeat, that the nervous power never generates motion, *per se* (§ 222–232). The function always depends immediately upon the organic property *mobility*, which is brought into action through impressions made upon irritability (§ 188). The nervous power is only a stimulus to irritability. But, it is much more important to motion in animal than organic life; since it is the only natural stimulus of the voluntary muscles, while blood, and other agents, operate upon the tissues with which they are in contact in organic life, and thus excite reflex nervous actions, and render them tributary as an exciting cause of muscular motion and in increasing or diminishing and otherwise affecting the secreted products (§ 224, 226, 475½, 893½).

260. Very important laws grow out of the foregoing distinction between the relation of the nervous power to the function of motion in animal and organic life, and its essential independence of that power in either life (§ 475½, 476, 498, 500 *m*, 893½, 1042).

261. That motion does not depend upon the nerves is shown by the sensible and insensible motions of plants; by that of their leaves, stems, stamens, by their absorption, nutrition, secretion, &c. (§ 455, *c*). The analogies in results prove this independence of the nerves, and the near identity of the function in plants and animals. Indeed, the chemists will have it that all the essential compounds of the animal are formed by vegetable organization (§ 18, 409). Such analogies are always sound, being based on great fundamental laws. But there may be great variety of mechanism. Where nerves exist, and in connection with centres capable of generating a stimulus, they are so far tributary to muscular and other motions, and voluntary motion is wholly dependent upon that stimulus, as also natural involuntary muscular motion.

262. "The heart of a frog continues to beat with its ordinary rhythm even when the entire base of the organ, when the ventricles, as far as their juncture with the auricles, are cut away" (p. 346, § 516 *d*, no. 8).

In the same way, "the peristaltic movements of the intestinal canal continue not only when the intestine is removed from the trunk together with the mesentery and ganglionic plexus, but also when the intestine itself is isolated from the plexus by being separated from the mesentery at the line of its insertion."—Müller's *Physiology*.

263. Dr. M. Hall tied a ligature around the root of the heart and lungs, and then separated them from the body. "The action of the heart was still such as to carry on, in a slight degree, and for a short period, the circulation of the blood through the pulmonary artery, and a few of the capillary vessels." He adds his belief, "that the actual circulation of the blood has not been before seen proceeding entirely and independently of the sympathetic system."—Hall.

264. Now, in the last two of the foregoing cases there may have

been local nervous centres, ganglia, perhaps, or some other part of the sympathetic nerve to supply the requisite stimulus through reflex actions; the air and the injuries operating as remote exciting causes of the nervous influence (§ 475½). But in the case of the mutilated heart the nature of the injury precludes the supposition that there could have been any radiating focus of reflex actions, which is probably equally true of the case in § 498 *e;* so that in those instances the air and the mechanical irritation were alone the exciting causes. NOTE A p. 1111.

265. Motion, therefore, whether voluntary or involuntary, is carried on through properties inherent in the various tissues, and the nervous influence is only a remote exciting cause, and in that respect on common ground with other vital agents, while also, as will be seen, it is an indispensable regulator of the organic mechanism of animals, and tributary to the perfection of their organic compounds (§ 222–233⅘, 500).

266. The nervous power, in developing motion in either organic or animal life, as a stimulus to the organic properties, does not follow the nerves according to their regular order of distribution from the nervous centres. On the contrary, its entire want of uniformity in that respect—operating simultaneously, at one time, through a nerve or nerves proceeding from the cranium and some inferior part of the spinal canal, while it passes over all intermediate nerves—or, at another time, electing, without any regularity in respect to order of arrangement, two or more of those intermediate spinal nerves—this entire want of respect to anatomical order is so familiar to all that it has not appeared as one of the most difficult and sublime problems of nature. This very extraordinary attribute of the nervous power is rendered the more remarkable by our knowledge of the fact that its operation is determined through particular nerves either by an act of the will, or, in organic life, by particular passions, by their intensity of operation, and by the special nature and intensity of physical agents which may transmit their influences to the nervous centres through some other part; and, in the cases relative to organic life, according, also, to the existing susceptibility of the various parts of the organism (§ 137 *d*, 143, 148–152, 233¾, 500, 892½ *v*, 893, 905, 1059).

267. All the foregoing are established facts, of perpetual occurrence; and they should be taken in connection with the doctrines which I have advanced as to artificial modifications of the nervous power, and the *modus operandi* of morbific and remedial agents (§ 224–233⅘, 497–500, 503, 506, 889 *a*, 891½ *k*, 892 *aa*, 893–905).

2. ABSORPTION.

268. Absorption is performed, in animals, by the lacteals and lymphatics; those vessels being very similar in their constitution and function. There are corresponding means for the office of absorption in the roots and leaves of plants.

269. Magendie, and others who have copied from him, have fallen into the error of attributing the office of absorption to the veins. He was led into the mistake by an ignorance of the fact that the lymphatics terminate variously in small veins.* Fallacies of that nature should be apparent upon principle alone—at least to such as recognize a unity of design, and a simplicity in the great institutions of nature. Every system of vessels, so far as known, has but one func-

* See *Medical and Physiological Commentaries*, vol. ii., p. 170, *note*, 380, 394–396.

tion, however that may be modified in different parts, as seen in the lymphatics and lacteals, in the terminal series of the capillary arteries in all parts, &c. The distinction depends either upon structure connected with the modifications of common vital properties, and their relative adaptations to the physical properties of different fluids, or, structure may be apparently less concerned than the organic properties; which is one of the most universal and important principles in physiology (§ 133–150).

270. The lacteals perform the office of absorbing, and introducing into the organization of animals, foreign nutritive matter.

271. The lymphatics, in greater part, are destined for the vital decomposition of the body, and for the removal of waste parts, which are conveyed by the lymphatics into the torrent of blood to be ultimately cast out of the system, or again to undergo, in part, the process of sanguification. May absorb from surfaces, but not nutritive matter.

272. By these vessels, also, the solids are removed in the ulcerative process of inflammation, and mortified parts are detached from the sound,* and foreign substances which are introduced into the body are taken up and removed.

273. Hence it is obvious that the lacteals and lymphatics are antagonizing systems, and that beings so endowed are the constant subjects of waste as well as of nutrition; the balance being maintained through the inlet supplied by the lacteals, and the outlet provided by the lymphatics (§ 180–182, 286). Notwithstanding, therefore, the coincidence in the general function of these two systems of vessels, the office of one is creative, that of the other destructive.

During the period of growth nutrition overbalances waste; but, when growth ceases, nutrition and vital decomposition must be *in equilibrio*.

274. No substances but such as exist in a fluid or very attenuated state are taken up by the lacteals and absorbents.

275. The intestinal villi have been shown by Cruikshank, Bleuland, and others to possess open orifices,† though this is denied by the microscopists; and I have shown that the modifying influence of the ganglionic nerves upon all the organic functions and products contradicts the hypotheses of catalysis and endosmose and exosmose (§ 1089).

276. Different substances are absorbed with various degrees of rapidity, both in animals and plants. This depends on their peculiar virtues, and on the manner, therefore, in which they affect irritability; thus showing the vital nature of the process (§ 149, 188, &c., 207). The same conclusion is also inferable from experiments, as well upon plants as animals.

277, *a*. Again, the lacteals, in virtue of their special modifications of irritability, exclude every thing but chyle. Bile is not taken up either by the lacteals or lymphatics; cathartics pass off; emetics are rejected. The principle is every where; is shown in the larynx, pylorus, &c., in the sparseness of the red globules in the lymph vessels, though their diameters be many times larger than the globules of blood (§ 399). The principle lies in the virtues of the agents and the special modification of irritability which belongs to each part (§ 135). It is designed for the conservation of every part, and of the

* See Med. and Physiolog. Comm., vol. ii., p. 168, 169, 171–173.
† *Ibid.*, vol. i., p. 683–690, 699–712.

whole. Had not the lacteals and lymphatics been endowed in this wonderful manner, or were absorption a mere physical process, or capillary attraction, or endosmose, all foreign substances would have free access to the internal parts of the organization, and organic beings would have had no continued existence. They would have perished as soon as created. Hence, are the vital properties so modified in all these millions of inlets into the labyrinth of organization that they shall be not only vigilant sentinels, but recognize, at once, every one of the thousand offenders that may endeavor to steal its way into the *sanctum sanctorum* (§ 192).

277, *b*. Some of the most important laws in medicine are founded on the special modifications of irritability in different parts (§ 149, 150); and as it respects the lacteals and lymphatics, the principle not only contradicts the assumption of the operation of medicines by absorption, but confirms, in a beautiful manner, the laws of sympathy.

278. It is only when the lacteals and lymphatics become morbidly affected, or their irritability essentially modified by the morbific action of agents offensive to the organization, that those agents are at all admitted, and then only very sparingly. The principle is the same as when undigested food escapes the pyloric orifice in indigestion, or the red globules of blood gain admittance to the serous vessels in inflammation (§ 14, 74, 117, 137, 143, 155, 156, 169 *f*, 266, 303¼ *a*, 306, 310, 313, 325, 387, 399, 409 *f*, 422, 514 *h*, 524 *d*, 525, 526 *d*, 528 *c*, 638, 649 *d*, 764 *b*, 811, 847 *c*, 848, 902 *f*, 905).

279. If, therefore, foreign agents affect the absorbent vessels in the foregoing manner, so also do they affect the condition of the other tissues of the part. This is the beginning of disease, which may now go on accumulating without any farther agency of the exciting cause; or, if the offending cause gain admission into the circulation, it may continue, *per se*, to exasperate disease. But, even in this case of the continued operation of morbific or remedial agents after their absorption, I have shown that solidism and vitalism can alone explain their effects (§ 819, &c.).

280. I have also shown that when morbific or remedial agents are taken into the circulation the quantity is so small, their dilution by the blood and other fluids so great, and their elimination by the kidneys so rapid (at least in a general sense), that little or nothing is likely to be contributed in this way to the morbific or remedial effects.

The rapidity with which agents that are not morbific, but useless to the system, are elaborated by the kidneys, is a proof, upon the principle of Design, that a provision exists for the exclusion of deleterious agents from the circulation. But, since they may, under special circumstances, pass the great sentinel (§ 278), the kidneys are provided as other guards to the general organism, to expel the offenders at once. Just so with the lungs. If offensive objects pass the larynx, all the muscles of respiration, through a beautiful system of Design, immediately set at work to get rid of the intruder. The intelligent reader will readily carry this principle to more recondite processes, as the institution of abscesses, and the curious steps that attend their progress from deep-seated parts toward the surface (§ 733).

281. It may be also added, that I know of no critical attempt having been made to invalidate the facts and the reasoning set forth in my Essay on the Humoral Pathology, which has for its object the ex-

posure of that pathology and the defense of solidism and vitalism; and, although that work has been now six years before the public, I know not that I have omitted the investigation of one essential fact or experiment that has been alleged or instituted in behalf of humoralism. If such omission has occurred, let it be shown.*

282. Many distinguished men have been led into the error of sup posing that noxious substances are taken readily into the circulation because the skin is deeply tinged with yellow, in jaundice; or because the bones become red when madder is eaten; or the urine is colored by rhubarb, or manifests the odor of turpentine, of garlic, &c. But, let it be considered, that the inoffensive coloring matter of the bile is alone absorbed, as is also that of madder and rhubarb, &c.; while the thousandth part of a grain of spirits of turpentine, or of garlic, is enough to impart all the odor to the urine that has been ever observed to attend that product.

283. If remedial and morbific agents be absorbed, it devolves upon the mechanical philosophers to show the fact, which they have failed of doing in regard to many of the most important (§ 826 *c*); but should their assumptions become realities, I shall have demonstrated by a multitude of analogies where absorption is out of the question, and in various other ways, that the *modus operandi* of the whole rests upon the philosophy of the natural physiological laws (§ 1088–1089).

284. Although a very limited operation of morbific and remedial agents, through their absorption into the circulation, be not incompatible with solidism and vitalism (§ 277, 278, 283, 827 *f*), the usual interpretation of their effects, according to the doctrines of humoralism, would compel us to abandon the application of physiology to medicine, whether pathologically considered, or in respect to the operation of curative agents. The laws of disease would be totally unlike the laws of health; or, rather, disease would be without laws, and there would, therefore, be no general principles in medicine. Practice would be a blind empyricism. Diseases would be just as various and uncertain as every chemical change in the blood, and these changes, upon the ground of humoralism, would have no resemblances to each other.

285. The properties of life lie at the foundation of physiology. It is a knowledge of their character, and of the laws which they obey, that enables us to conform our habits, at all ages, in the best way for the maintenance of health. But, what is disease? It is a deviation from the state of health; and, therefore, if there be any consistency in nature, disease should consist primarily and essentially in modifications of those vital properties, which, in a different state, constitute the important conditions of health. In this way, therefore, medicine takes the rank of an intelligible and important science. Physiology is the ground-work throughout. Pathology becomes nothing more than physiology modified. And, coming to therapeutics, it is still physiology applied to the cure of diseases; or, in other words, the application of such agents to the morbid properties of life as shall aid their restoration to their natural physiological state. The whole is thus bound together. No new elements come into operation; but, throughout the whole series of changes, the same powers are in action and carry on all the processes. Nor are there any new laws introduced. The powers and actions being fundamentally the same,

*In *Medical and Physiological Comm.* vol. i. 1840.—Now 25 years, and no attempt made. —1865.

so are the laws, of health and disease, as are those, also, by which diseased are converted to healthy conditions. But, the powers or properties of life being modified in disease, and again modified in other ways by the action of remedial agents, so are the laws, under which all these results happen, varied in a corresponding manner. The laws are only the conditions under which effects take place; and, as those effects have always a direct reference to the state of the vital properties, they must be fundamentally of the same nature under all the various conditions of life, since, also, the vital properties never lose their fundamental character (§ 1, 639).

286. When, therefore, I may speak of the laws of health and the laws of disease, I must not be understood as meaning something entirely different in the two cases. And yet, their modifications are always precise, and the results of each are always determined in one uniform manner. This is necessarily so, because the changes in the vital properties are always precise, and according to the nature of the influences by which the changes are effected (§ 149, 150).

287. In this sense, therefore (§ 286), the laws may be assumed to be, in each individual modification, of a specific nature.

288. Laws may be said to be general and specific; which, however, is only another mode of considering the foregoing principle (§ 285). Thus, it is a general law that the absorbents, whether in health or disease, do not take up foreign substances of a deleterious nature; but, it is a specific law, that when the irritability of the lacteals or lymphatics is modified in a certain way, they will admit a small proportion of the noxious agent by which the alteration is produced (§ 277, 278).

289. Those mechanical physiologists who have not, or will not have, just conceptions of the properties and actions of life, refer the process of absorption to capillary attraction, or that mechanical principle which determines the ascent of oil in the wick of a lamp (§ 277). The chemists belong to this class of reasoners; even such of them as allow the existence of a vital principle. Thus, for example, Liebig has it, that,

"A *cotton wick* inclosed in a *lamp*, which contains a liquid satura ted with carbonic acid, acts exactly in the same manner as a living plant in the night. Water and carbonic acid are sucked up by capillary attraction, and both evaporate from the exterior part of the wick." Again, "All substances in solution in a soil are absorbed by the roots of plants exactly as a sponge imbibes a liquid, and all it contains, without selection."—Liebig's *Organic Chemistry applied to Physiology and Agriculture.*

Now all this might be very good philosophy for a common agriculturist; but it evinces an unaccountable disregard of facts, and of the plainest suggestions of nature. And yet it is a common doctrine now-a-days; a part of the "new experimental philosophy." In the first place, however, it is not true that the roots of plants imbibe their nourishment "without selection." When plants are cultivated in glass vessels containing distilled water, their roots will even decompose the glass, and select its silica, or alkali, or take them both, and assimilate them to themselves, and in the absence of any known chemical affinities or influences. Absorption is nearly as exact in plants as in animals; and so is appropriation. Like animals, their absorbent system

is naturally repulsive of every thing that is offensive and not suitable to their economy. If poisons, when artificially applied, get admission, it is by inflicting a violence on the radicles of plants (§ 278). And what is thus prompted by reason, by analogy, by common experience, is fully confirmed by the chemists themselves, in those analyses of all parts of a plant, even the sap, which are designed as standards of the composition which shall serve for any particular part of any given species of plant, as well through all future time as at the hour when the analyses were made (§ 1052, 1053, 1054).

290. The simile of the "lamp-wick," and of the "sponge" (§ 289), show us how far astray our friends are from the path of truth. It is not alone the complex mechanism of the root which the absorbed materials traverse, but a labyrinth of highly organized and living tubes, passing through the whole trunk of the plant, till the materials finally reach the leaves. In those respiratory organs, the *pabulum vitæ* is farther subjected to the action of another complicated, unique, and living system of vessels. And what is the "wick of a lamp?" A mere bundle of dead, disorganized fibres, broken upon the card, and spun upon the wheel (§ 350½ *n*, *o*, 826 *c*).

291. But, the foregoing degrading doctrine of life (§ 289) is not peculiar to the chemists. Some reputedly profound physiologists apply it not only to plants, but to animals, and, like Liebig, identify the same vital and physical processes. One example, in a distinguished quarter, will suffice. Thus, Dr. Carpenter:

"It will be hereafter shown that the absorption of nutritious fluid is probably due to the *physical* power of endosmose. A continued absorption may be produced by a *physical contrivance which imitates the effects of vital action;* [!] *as in the wick of a lamp, which draws up oil to supply the combustion above, but will cease to do so when the demand no longer exists*"! (§ 64 *g*, 175 *d*).—CARPENTER'S *Comparative Physiology*.

The work, a standard one, from which the foregoing is quoted, abounds with analogous doctrines. They are, of course, fatal to physiology and to all medical science.

292. Immediately after the quotation from Liebig, in the preceding section, that author proceeds to reprobate physiologists for their exclusion of chemistry from organic life, and charitably regards it as a prejudice arising from our ignorance of the science (§ 350, *a*). This, however, is quite an untenable position; for, wherever medicine is cultivated chemistry is justly made a fundamental part of education. It is, indeed, the knowledge which the soundest physiologists possess of chemical science that enables them to institute the necessary contrasts, and which convinces them that chemistry, in its proper acceptation, has no connection with the processes of living beings. This, indeed, I have abundantly shown to be the real opinion of the chemists themselves (§ 350, &c.). Bold in assumption, inapt in illustration, and, at last, like Liebig, contradicting the whole by an acknowledgment that "*vitality, in its peculiar operations, makes use of a special apparatus for each function of an organ*," and that "*in the living organism we are acquainted with* ONLY ONE CAUSE OF MOTION; *and this is the* SAME CAUSE *which determines the growth of living tissues, and gives them the power of resistance to external agencies.* IT IS THE VITAL FORCE."—LIEBIG (§ 350, nos. 26, 27, 28, 71–77, &c.).

293. Looking at other facts attending the process of absorption in plants, we shall find them all concurring with what I have already stated as to the dependence of this function upon vital actions; and, if vital here, we need not look for other proof of a similar law in animals. Thus, Van Marum demonstrated that absorbed fluids could rise only eight inches by capillary attraction. Hales, Walker, Mirbel, Chevreuil, and others, have shown that the sap moves with such velocity and force in plants, that it must be propelled by vital contractions and dilatations of the vessels. We have examples of this surprising rapidity of the circulation in grape-vines. Don and Barbieri affirm that they saw the movements of the vessels.

Again, the motion of sap is increased by light, heat, and other stimuli, which have no effect on capillary attraction. And this is the opinion even of Liebig, who says that "the FUNCTIONS of plants certainly proceed with greater intensity and rapidity in sunshine, than in the diffused light of day; but it merely ACCELERATES in a greater degree THE ACTION ALREADY EXISTING;" "an action," he says, "which *depends on the vital force alone.*"

It was shown by La Place, that, if the sap rose by capillary attraction, it should not, as it does, flow from the openings made in the vessels. But, again, the sap will not flow from the openings, if the plants be poisoned with prussic acid. The effect is the same as upon the circulation of the blood; and it would be equally absurd, in either case, to suppose that the poison acts upon any physical force. Astringents, and various other substances, applied to the openings, avert the flow of sap, which can only be done through the foregoing principles (§ 278–284, 1054).

294. Here is another fact, and which appears to be conclusive of the vital nature of absorption, and of the discrimination observed by the radicles of plants (§ 289, 291). It is, that the sap of the root is unlike any thing which it absorbs from the earth. All the substances are decompounded at the moment of entering the roots, just as the carbonic acid is by the leaves. Their elements are then also united according to the modes which prevail in organic compounds (§ 38, 42).

295. Equally unfounded as the doctrine of capillary attraction are the supposed processes of endosmose and exosmose. They are generally predicated of experiments upon dead matter, and are then carried, by way of analogy, to the living organism, and in defiance of all the contradictory phenomena of life.* Having entered extensively into a refutation of the hypothesis of endosmose and exosmose in the Medical and Physiological Commentaries, I shall not now resume the subject (§ 1052, 1053, 1054).

3. ASSIMILATION.

296. By the function of assimilation substances taken into the body are converted into the homogeneous blood, and identified in composition and vital properties with all parts of the body. It is therefore especially concerned in the process of growth, and in supplying the waste which is constantly in progress. It is the function, therefore, by which the properties of life are communicated to dead matter.

297. All dead matter, before its reception into the body, is subject to the forces of chemistry. The operation of these forces is arrested in the alimentary canal of animals, and in the absorbing vessels of plants.

* Violence is inflicted in the experiments upon living tissues.

298. The nutriment of vegetables consists always of inorganic substances, or is reduced to the condition of inorganic matter before its appropriation. The food of animals is always organic. The former exists in an elementary or in a state of binary combination, the latter of ternary, quaternary, &c. It is the work of vegetable assimilation to overthrow the chemical combinations, and to unite the elements in those very different modes which constitute organic compounds. This is the most remarkable and comprehensive System of Design of which we have any knowledge (§ 1052).—NOTES NR pp. 1121, 1123.

299. Assimilation, therefore, devolves especially upon the properties vivification and vital affinity (§ 216, 218); though it be certainly true that all the organic powers and functions are necessary to each other, and concur together in producing every result. But, in every result there are some more interested than others.

300. Animals, being incapable of organizing inorganic substances, are dependent upon the vegetable kingdom as their ultimate source of supply (§ 13, 14). Such, indeed, is the final cause of vegetable life. But the food of animals must be dead before it can begin to undergo the action of the vital properties in another being. The gastric juice, for instance, has no effect upon any living substance.

301. No organic compound ever undergoes chemical decomposition, or any approximation toward such decomposition, to fit it for the purposes of animal life. On the contrary, every such tendency places the appropriate nutriment of animals, more or less, beyond their assimilating endowments. It is the province of animal life, and of all its provisions for assimilation, not to carry back toward their inorganic condition the peculiar compounds generated by the vegetable kingdom for the foreordained uses of the animal, but to carry them forward to yet higher degrees of life and organization. This is one of the most fundamental laws of nature, and is conclusive against all the chemical speculations with which physiology has been so unhappily visited (§ 356 *b*–376).* The argument belongs to me (§ 1084).

302, *a*. The assimilating organs in vegetables are more simple than in animals, and the complexity increases in animals according to their rank in the scale of life. It would appear, therefore, that organization bears a ratio more or less proportionate to the endowment of organic compounds with the properties of life (§ 301, 409).

302, *b*. The process of converting inorganic into organic compounds begins in two orders of vessels, one of which are the radical absorbents of plants, the other analogous vessels in the leaves.

The matter absorbed by the roots ascends through the stem to the leaves, where, by the operation of a series of vessels, variously modified in different species, it is converted, along with that absorbed by the leaves, into a juice, which, like the blood, is thus fitted for the purposes of nutrition. This juice then descends through other vessels, to be appropriated to all parts, and to form the source of all the various products of vegetable organization.

303, *a*. We come, therefore, to a conclusion as remarkable as it is comprehensive, that the atmosphere is not only essential to plants and animals in its usual acceptation, but that it supplies the great means of nutriment to both organic kingdoms: directly to the vegetable, and indirectly to the animal department (§ 298–300). Mineral compounds appertaining to the earth must yield the less important elements, and

* Chemists are beginning to adopt this conclusion, as appears in *Note* at p. 196.—1860.

even some proportion of oxygen through the decomposition of rocks and metals and the appropriate combinations that may ensue; but we must look especially to the atmosphere and what it contains for the four great elements which compose organic beings. The oxygen and the nitrogen of the air, the oxygen and the hydrogen of the vapor which the air contains, and the carbon of the carbonic acid, are as much at this day the great source of nutriment to plants, as before the "mist" went up from the seas, or animals yielded ammonia. Oxygen and nitrogen, therefore, as it respects atmospheric air, are appropriated by plants in their elementary condition. Upon organic compounds thus formed is animal existence, in the main, dependent. Ammonia certainly contributes to the nourishment of plants. But this is an incidental means, at least if there be any truth in Moses. And that his Record is true, is plain enough upon the principle of Design; since it is impossible that Providence should have created the animal kingdom, which yields the ammonia, before he brought forth that kingdom upon which animals depend for their existence.

303, *b*. As it respects *absorption*, the leaves and the roots of plants appear to have a common office, though the former are designed especially for assimilation. The carbonic acid, and the oxygen and the nitrogen of the air, are precipitated along with the vapor, and thus reach the organs which are principally devoted to absorption. In no other way can we primarily reach the materials of all organic beings. Before their absorption can have begun, the most essential elements must have been embraced originally in the atmosphere, and in the simple conditions which I have stated. Nor is it a difficult process to follow out that circuit of causes and effects in which revolves the economy of nature in making the waste of organic beings during their own existence a subsidiary supply of nourishment to themselves, or to others of their own day, or to generations in the womb of time; or, when consigned "to the dust," how their elements, from one generation to another, form an endless round of materials for reproduction and growth, either in the form of gases and vapor diffused in the air or as imbodied with the earth.

303, *c*. Although it be the special object of the radical fibres to carry on the function of absorption, this office is more or less performed by the leaves of plants, but in various degrees, according to the nature of the species. In arid climates, the leaves have this function strongly pronounced; and many plants, like the *sempervirens*, will grow as well when suspended by a string, as when connected by their roots with the soil.

303, *d*. The leaves of plants absorb carbonic acid mostly during the day, decompound it through a vital process, and otherwise prepare it as an important source of nourishment. Light is necessary to this function of the leaves, and without it the plant languishes and dies. As an attendant result oxygen gas is evolved into the atmosphere. The process is, therefore, suspended during the absence of light, and some proportion of carbonic acid is regenerated and escapes along with the vapor which is exhaled by the leaves. It has been also supposed that more or less oxygen is absorbed at night; but this opinion appears not to be sustained by later and better observations. It is most probable, indeed, that the temporary absence of light occasions scarcely more than a suspension of the assimilating process. Light acts as a vital

stimulus to the leaves, by which their organic properties are rendered capable of overthrowing that most refractory compound, carbonic acid (§ 188½ *d*, 350, nos. 64, 66, 68–76,)

303, *e*. The leaves of plants being the great organs of assimilation, and light the vital stimulus by which the function is maintained (§ 188½, *d*), it appears from what has been now said that *light* holds the first rank among the requisites of life. It was therefore brought into existence before the creation of the vegetable kingdom; and being thus indispensable to all living beings, we see the fallacy of a common tenet in theoretical geology, that the most thrifty period of vegetation was through a great cycle of total darkness, and an atmosphere of carbonic acid (§ 74, 1079 *b*).

303¼, *a*. One of the most interesting facts in vegetable physiology is the immediate necessity of plants to animal life during their very growth; their final cause, in this respect, being the abstraction of carbonic acid from the atmosphere, and the renewal of its oxygen. Animals, too, as we have seen, incidentally contribute carbon to the vegetable kingdom, in the form of carbonic acid, and nitrogen in the form of ammonia. There is this remarkable subserviency of the organic kingdoms to each other, though there be not a reciprocal dependence. Vegetables, indeed, preceded animals, and are, therefore, essentially independent, while animals derive all they possess from vegetable creation (§ 303, *a*). Plants are the producers, animals the consumers. The former directly, and the latter indirectly, live upon the air and what it contains. The plant dies and becomes food for the animal; but it seems scarcely less important in its living state to the exigencies of animal life. And so the animal, living and dead, yields back its all to the atmosphere; and thus are the inorganic, and the two departments of the organic, kingdoms united (§ 1052, 1053).

303¼, *b*. But, we have seen, as I originally indicated in the Essay on the *Philosophy of Vitality*, that the supply of ammonia to the atmosphere is only a contingent result of the creation of animals, and therefore not indispensable to vegetation (§ 156 *b*, 303 *a*). Liebig, however, reverses the order of Creation, and affirms that

"We have not the slightest reason for believing that the nitrogen of the atmosphere takes part in the process of assimilation of plants and animals." "These facts are not sufficient to establish the opinion that it is ammonia which affords all vegetables, without exception, the nitrogen which enters into the composition of their constituent substances. Considerations of another kind, however, *give to this opinion a degree of certainty which completely excludes all other views of the matter.*"—Liebig's *Organic Chemistry*, &c., p. 70, 71.

303¼, *c*. The same mistake has arisen with the chemists as to the reciprocal dependence of animals and plants, in regard to the excretion of carbon by one and oxygen by the other. However true it may be that animals are dependent on plants for oxygen gas, it is certainly an assumption that the vegetable kingdom is alike dependent on the animal for its carbonaceous element. If the primary creation of plants be admitted, that is sufficient; and to those who reject the Mosaic Record, and the concurring testimony of geologists, I may repeat the admitted fact that vegetables are the ultimate source of supply to all animals. The former, therefore, are essentially independent, the latter dependent; while this universal fact corroborates, also,

the original account of the primary creation of the vegetable kingdom (§ 303¼).

As to the relations of the living plant to organic life, it is computed by Saussure, and allowed by others, that the atmosphere contains about $\frac{1}{1000}$th part of its weight of carbonic acid. The atmosphere must be also losing, through the processes of respiration, combustion, &c., a proportion of its oxygen. It is estimated, also, that the present number of human beings would, alone, double the existing quantity of carbonic acid in the air in 1000 years; and, in 303,000 years would exhaust its oxygen. It is also found that atmospheric air of the present day does not contain less oxygen than that which is found in jars buried for 1800 years in the ruins of Pompeii.

From all this it is inferable that there is a universal cause in operation, by which the carbonic acid of the air is consumed, and oxygen supplied; and, from the various well-known, and indispensable uses of the vegetable kingdom to the animal, *which declare its creation for the benefit of the latter*, and, therefore, its antecedent or simultaneous creation, we should naturally be prompted, by analogy, to look to this subordinate provision as the universal source through which the great purposes of respiration are maintained unimpaired. Chemistry has here elegantly illustrated this great element in the final causes of the vegetable kingdom, and the contingent aid which it derives from the animal; while it enlarges our view of the vast conceptions of Unity of Design.

303½. It is also worth our while to observe of these important laws, as we go along, how they are perverted by the ignorant in physiology, and how incapable the chemist is constantly proving himself of "pursuing his reasoning," as said of him by Hunter, "even beyond the simple experiment itself."

Vegetables, as we have seen, are composed mainly of carbon, oxygen, hydrogen, and nitrogen (§ 37, 303). The carbonic acid of the air (as well as of the soil) is absorbed by plants, and appropriated to their nourishment and growth. This gaseous substance, therefore, is decomposed by vegetable organization, the carbon vivified and appropriated, and a part of the oxygen thrown off to replenish the atmosphere. It is incorrectly said, however, by Liebig, that "the atmosphere must receive by this process a volume of oxygen for every volume of carbonic acid which has been decomposed." It may be meant, however, that an equivalent or atom of oxygen for every equivalent of carbon is given off to the atmosphere; but even this construction is invalidated by the multiplicity of sources from which plants are supplied with that important element. But enough is known to render it certain that a large proportion of the oxygen of carbonic acid is retained by plants and combined under a new form along with the carbon and other elements. Liebig's hypothesis of capillary attraction led him, not improbably, to overlook the fact that the water which is absorbed by plants is actually decompounded, and its elements combined with others according to the laws which determine organic compounds. It is water, indeed, which yields, far more than ammonia, the hydrogen which abounds in plants (§ 303, *b*). Water, therefore, being composed of oxygen and hydrogen, furnishes a source of the supply of that oxygen which goes to the increase of vegetables; and, for aught that can be said to the contrary, it may form a part of what is evolved into the air.

We have seen, also, that plants derive a part of their oxygen from mineral compounds appertaining to the earth, and probably by means of the roots from the atmospheric air which is held in solution by water, when the gas may be thus appropriated, notwithstanding its elementary condition in the latter case. Although, doubtless, more or less carbonic acid is reproduced in the leaves and escapes at night along with the vapor exhaled, the probabilities are against the supposition that a proportion is also then generated and emitted by plants in a manner analogous to the respiration of animals, and having for its object, in part, the separation of carbon from some of the vegetable constituents.

303⅔. But let us come to philosophy:—

"At night," says Liebig, "A TRUE CHEMICAL PROCESS COMMENCES, in consequence of the action of the oxygen of the air upon the substances composing the leaves, blossoms, and fruit. This process is not at all connected with the life of the vegetable organism, because it goes on in the DEAD plant EXACTLY as in a LIVING one"!

Here, in the first place, is an important fallacy in the premises from which the induction is made; since the processes have not the least analogy in the living and dead plant. In the former, the oxygen is taken into the organization, and goes to form organic compounds. In the dead plant, it is an agent of chemical decomposition, by which the organic compounds are destroyed, and the structure broken up.

Now we shall always find that authors who reason in the foregoing manner perpetually contradict themselves. In the case before us, a contradiction necessarily arises from the fundamental differences between the processes of organic and inorganic beings, and the laws by which they are governed. A little farther on from the quotation I have just made, Liebig affirms that "*the laws of life cannot be investigated in an organized being which is diseased or dying.*" Here, then, is a contradictory opinion, which inculcates as great an error in physiology as that of identifying the effects of oxygen on "living beings" and on such as are actually dead. Here is an absolute denial of any analogies between the laws which govern living "diseased beings" and the "laws of life." But, this declaration of the chemist, devoid of truth as it is, is universally applicable where he would be least disposed to see it operate. Such an application, too, is an irresistible *sequitur;* since, if "*the laws of life cannot be investigated in an organized being which is diseased* or dying," it certainly follows that the laws which relate to dead, or inorganic beings, and the forces upon which those laws depend, can have no agency in living beings.

Such, however, is the material which is now-a-days denominated "experimental philosophy," and "the progress of medical science." And, if the reader will now turn to the parallel columns (§ 350), he will see yet other contradictions directly relative to the foregoing quotation (§ 1052, 1053).

But, it may, perhaps, be well enough, before dismissing this subject, to say, that, although "the laws of life cannot be investigated in an organized being which is dying," the laws which govern diseased actions and their results are only slightly modified "laws of life," and often reflect great light upon their strictly healthy condition. We are, or should be, constantly reasoning in this manner in all cases of disease; and it is only by comparisons of the modifications, which constitute disease, with the natural conditions of life, that we can have

any just knowledge of diseases. In proportion, however, as the individual approximates a state of death all this reasoning fails; and, when actually dead, no such comparisons can be instituted. Here, then, it is that the foregoing admission of the chemist applies with all the force of truth (§ 639 *a*).

304. The greater complexity of the organs of assimilation in animal life gives rise to a variety of subordinate functions in animals not found in plants; such, for example, as digestion by the gastric juice, saliva, bile, &c.; then a farther advancement of the process in the lacteals, in the blood-vessels, in the lungs, &c. Some of these subordinate functions, however, have their analogies in plants; such as the action of the sap-vessels upon the circulating fluid, the imbibition and exhalation of gaseous substances by the leaves, &c. But, in all the cases, the extreme vessels which perform the office of nutrition are the main instruments of organic life. All the functions which are carried on by compound structures are subsidiary only to that of the nutritive vessels (§ 171).

305. The organs of assimilation in animals are more or less complex according to the nature of the food. Probably every animal has a stomach, or some analogous organ, and a mouth, and anus, which would form, as supposed by Aristotle, a fundamental distinction between plants and animals (§ 11). The analogies which are supplied by the higher orders of animals would prompt this conclusion in respect to the most inferior, or some equivalent arrangement.

306. In vertebrated animals the stomach is generally an expanded portion only of the intestinal canal. In fishes the intestine is commonly short; but this is often compensated by folds in the mucous membrane. In birds there is a complexity of the alimentary organs which does not exist in fishes, amphibia, or reptiles. In mammalia the digestive organization is still different; and here it is more remarkably various according to the nature of the food, and as the necessity of supplies may be felt at short or at longer intervals. The more, also, the phenomena of animal life are multiplied the greater is the development of the digestive system (§ 107, 251, 353). Its complex nature has an intimate relation to the qualities of the food, and these relations have an affinity with that principle of instinct which directs animals in the selection of food. The more dense and tough the food, and the more removed from the nature of the body which it is destined to nourish, the more complex are the organs of digestion. And so, on the contrary, the softer the food, and the more it is like the animal in its composition, the more simple are the assimilating organs. Animals, therefore, which live on hay have these organs much more complex than such as are nourished by animal food; especially that part of the organization which is destined to make the first and greatest change.

307. The principal agent in the assimilating process, in animals, is the gastric juice; a vital organic fluid, which is secreted by the internal coat of the stomach (§ 135 *a*, 316, 419, 827 *b*). This secretion is especially promoted by the stimulus of food, which is dissolved and altered in its elementary constitution by the vital influences of the juice. This is the first and greatest step in the process of assimilation. It is here that dead matter receives its first impressions from the properties vivification and vital affinity (§ 216, 218). The chemists tell us

that the process is a chemical one; and that, notwithstanding the various, and unique, and astonishing devices of nature for the elaboration of the gastric juice, they would persuade physiologists into the belief that many different processes of the laboratory will generate a gastric juice with all the unique properties that appertain to the fluid as elaborated from the blood by the various modifications of organization which were instituted by Almighty Power for these specific objects. And having been thus regardless of the most sublime and profound institutions of that Power, they proceed to assume that the product of these artificial compounds, in their action upon food, is the homogeneous chyme of living nature, and which is apparently the same in all animals, whatever the kind or the variety of food. But the chemist is met at the very threshold by the fact, that there is nothing in organic nature itself that can elaborate that fluid from the blood but that particular part of the great system of mucous membranes which forms a component part of the stomach (§ 135, *a*).—NOTES N R.

308. The foregoing relates to complex animals; but analogy, as well as observation, renders it evident that the inferior races possess an organization which is equivalent to the stomach (§ 251).

309. In most animals that consume food of a solid nature, there are preparatory organs which assist mechanically, by dividing the food. The construction of these organs of mastication, both as to their osseous and muscular parts, has a strict reference to the kind of food upon which the animal is destined to subsist. Animals of prey are furnished with organs for the destruction of life and organization; since no substance which possesses life can undergo digestion, and all solids must be divided to admit of a free access of the gastric juice and saliva.

310. The organs of mastication are more various than any other parts; yet so uniform in each species, so allied among numerous species, that naturalists have taken these characters not only as significant of the species, but as the foundation of a systematic distribution of the species into genera, and of genera into orders.

311. Where the usual organs of mastication are deficient in animals, the species is often supplied with means in the stomach itself for reducing the aliment to a soft substance, so that it may be penetrated by the gastric juice. The stomach of the armadillo, which subsists on insects, and of the granivorous birds, is endowed with a powerful muscle for crushing, or grinding the food. The stomachs of other animals are armed with bony or horny parts, as in many insects.

312. The food is moved about in the stomach by the muscular action of the organ; but so peculiar and exquisite is the modification of irritability of the pyloric orifice, the food is not permitted to pass this outlet till it is converted into chyme (§ 278). Much of the aqueous portion, however, is early and rapidly absorbed by the stomach.

313. When, however, as we have seen, the irritability of the pylorus is artificially modified, as in disease, it will often allow undigested food to pass, more or less readily, into the duodenum (§ 278). But it is more remarkable that it will suffer many hard, indigestible substances to escape, while it detains such as are most congenial to its nature. The passage of indigestible substances is effected gradually by repeatedly presenting themselves at the pylorus, and thus so habituating the irritability of that orifice to their own irritant effects, but not to those of digestible food, that they are allowed to pass, while

the latter is detained; the stomach thus electing what is most congenial to its nature and to the wants of life (§ 188, &c., 539 *a*, 543, 551).

314. The saliva, bile, and pancreatic juice are auxiliary to the gastric juice, though how far is considered problematical. The liver is found, under a great variety of forms, in all animals whose structure can be made the subject of ocular demonstration, and it is known to generate bile in all instances. The pancreas and salivary glands occur in all the mammifera, birds, and reptiles, and in many fishes, mollusca, and insects.

From the general occurrence, therefore, of the foregoing organs, it cannot be doubted, independently of the more direct facts, that the fluids which they secrete have an important vital agency in the process of assimilation.

315. Animals which live on vegetables have larger salivary glands than such as feed on animal substances; and, since vegetables require greater assimilating means than animal food, it is a just inference from final causes that the saliva answers a far more important object than, as is commonly imputed to it, of moistening the food and facilitating its passage to the stomach. On the other hand, however, it has been with still less reason imagined by others that it contributes more than the gastric juice to the conversion of food into chyme. But here, as on all speculative questions, some distinguished chemists refer the agency of the saliva in the process of digestion to the atmospheric air it conveys to the stomach, while others of equal renown attribute this high office to its own specific virtues.

316. The bile and pancreatic juice mingle with the chyme in the upper part of the duodenum, where it is probable that the latter fluid contributes an assimilating influence analogous to that of the saliva; while the disappearance of some of the components of the bile, and other relative facts, show a direct connection of this fluid with the process of assimilation. The bile also separates the excrementitious from the nutritious part of the chyme; the former portion occupying the centre of the canal, and the latter the parietes (417, *b*).

Connected with these important uses of the bile is its well-known function of maintaining peristaltic action. Such, therefore, being its great final causes, we may safely reject the hypothesis of the mechanical theorists, that the liver, like the lungs, is designed to depurate the blood. The injury consequent on the failure of the liver, by experiment or otherwise, to perform its function, no more proves its supposed depurating office than a like contingency befalling the stomach would place that organ in the same category.—See § 1031–1033.

317. The intestinal tube, like the roots of plants, is supplied with absorbing vessels, which are called *lacteals* in animals of complex organization. The nutritive part of the chyme is taken up by these vessels, where it undergoes a farther assimilation, and receives the name of *chyle*.

Nothing is absorbed by the lacteals which is offensive to their exquisitely modified irritability, excepting under the circumstances already set forth (§ 278).

318. In the higher animals the chyle is transmitted by the lacteals to the thoracic duct, and by this vessel to the left subclavian vein, where it mingles with the general mass of blood. Thence it passes to the right cavities of the heart to be sent to the lungs, where it re-

ceives another important impress of vivification, parts, for the first time, with a portion of its carbonaceous matter, and undergoes a development of its coloring principle. From the lungs, it passes with the old blood, with which it is now fully incorporated, to the left cavities of the heart, to be transmitted to all parts of the body to undergo the last act of assimilation.

319. Assimilation advances progressively from the first conversion of food into chyme till the nutritive matter becomes vitally united with the solid parts. At each step of the process, in the stomach, in the duodenum, through the lacteals, in the lungs, and at its final destination, the degree and kind of assimilation is forever the same, at each of its stages, in every species of organic beings; thus denoting specific powers and laws by which all this unvarying exactness is maintained (§ 42).

Assimilation is more simple in animals low in the scale of organi zation; but close analogies prevail throughout.

320. The chyle is found to exhibit globules under the microscope, of which some are reddish. It is said, also, that they have been seen in the chyme; but Müller thinks that impossible, as the lacteals, according to him, have no open orifices, and, therefore, the globules could not be admitted through the "invisible pores" of the closed lacteals. These vessels, however, have open terminations by the villi of the intestines (§ 275, 1089).

These questions as to the existence and shape of the globules of blood, chyle, milk, &c., are of very little practical importance and are apt to lead to much waste of time, and encumber medicine with speculation and false doctrine; while the instrument, through the aid of which the imagination is thus sent upon its airy flight, is also the imbodyment of a thousand falsehoods in the path of truth (§ 131, 251).

321. Since, however, no one doubts that the nutritive part of the chyme undergoes a very positive change in the lacteals (§ 320), and a higher degree of assimilation, the proof is the same here, as in absorption by plants, that the fluid is not taken up and carried forward by capillary attraction (§ 289–291).

322. Looking back upon the variety of parts which are concerned in the work of assimilation; their exact adaptation to each other; their peculiarities in different species of animals according to the nature of their food—varying, indeed, more or less in every species, yet always alike in all individuals of the same species; the prevalence of four specific digestive fluids, and each of these analogous in all animals, notwithstanding the variety in the structure of the secreting organs, yet only generated, respectively, by one special part, their production in unusual quantities, especially of the gastric juice, to meet the exigencies of digestion; the apparently exact similarity in the composition of the chyme of all animals, whatever the nature and the variety of the food; it appears to be one of the highest absurdities to suppose that all this complexity of parts, all this magnificence and variety in Design, should be merely intended to subserve a chemical reduction of food in the stomach, especially, too, as all that is known of chemistry is in conflict with every part of this stupendous whole. And when we pursue the other steps through which the great end of digestion is attained, and steadily regard each individual part forever giving rise to certain unvarying results, each part in its anatomical

and vital relations to all the rest, the necessity of every part to every step in the process of assimilation, the necessity of the whole to every secreted solid and fluid, the derivation of the whole unique and forever exact variety (millions upon millions, § 41–46) from four elements mainly, out of a homogeneous fluid which embraces yet fourteen other elements, the necessary co-operation of many of the secreted fluids toward their own formation individually, and toward every formation in the complex animal—when, I say, we duly consider this labyrinth of complexities, moving on in one unvarying round of harmonious action and results, moved by a power within which has no known analogy in the world where chemical results obtain, we may reconcile unbelief in all this Design with a yet higher order of infidelity, but certainly not with the ordinary promptings of reason, or with the plainest rules of evidence (§ 638).

But, let us analyze, in another section, the great plan of nature for the maintenance of organic life in animals.

323. Let us analyze, after the manner of Cuvier, the constitution of animals in respect to the subserviency of the various parts of the fabric to the single function of digestion, and according to the nature of each species of animal; and when we shall have reflected upon the principles which determine the coincidences, and see that no one of them can be explained by any of the forces and laws of the inorganic world, let us cast from us, as unworthy a thoughtful mind, the supposition that the final act, or that of digestion, is a chemical process; and let us also apply the same induction to every other process of living beings.

"Every organized being," says Cuvier, "forms a whole, a unique, and perfect system, the parts of which mutually correspond, and concur in the same definite action by a reciprocal reaction. None of those parts can change without the whole changing; and, consequently, each of them, separately considered, points out and marks all the others. Thus, if the *intestines* of an animal are so organized as only to digest flesh, and that fresh, it follows that the jaws of the animal must be constructed to devour prey, its claws to seize and tear it, its teeth to eat and divide it, the whole structure of the organs of motion such as to pursue and catch it, its perceptive organs to discern it at a distance. Nature must have even placed in its brain the necessary instinct to know how to conceal itself and lay snares for its victims. That the jaw may be enabled to seize, it must have a certain-shaped prominence for the articulation, a certain relation between the position of the resisting power and that of the strength employed with the fulcrum; a certain volume in the temporal muscle, requiring an equivalent extent in the hollow which receives it, and a certain convexity of the zygomatic arch under which it passes. This zygomatic arch must also possess a certain strength to give strength to the masseter muscle. That an animal may carry off its prey, a certain strength is requisite in the muscles which raise the head; whence results a determinate formation in the vertebræ and muscles attached, and in the occiput where the muscles are inserted. That the teeth may cut the flesh, they must be sharp, and they must be so more or less according as they will have more or less exclusively flesh to cut. Their roots should be more or less solid, as they have more and larger bones to break. All these circumstances will, in like manner, influence the de-

velopment of all those parts which serve to move the jaw. That the claws may seize the prey, they must have a certain mobility in the talons, a certain strength in the nails; whence will result determinate formations in all the claws, and the necessary distribution of muscles and tendons. It will be necessary that the forearm have a certain facility in turning, whence, again, will result certain determinate formations of the bones which compose it. But, the bone of the forearm, articulating in the shoulder-joint, cannot change its structure without this also changes."

Again, observe what may be inferred from some other given part, as from the shape of the bones: "The formation of the teeth bespeaks that of the jaw; that of the scapula that of the claws; just as the equation of a curve involves all its properties. So the claw, the scapula, the articulation of the jaw, the thigh-bone, and all the other bones separately considered, require the *certain* tooth, or the tooth requires them, reciprocally; and, taking any one of them, isolated from the skeleton of an unknown animal, he who possesses a knowledge of the laws of organic economy, could expound every other part of the animal. Take the *hoof*, for example. We see, very plainly, that hoofed animals must all be herbivorous, since they have no means of seizing upon prey. We see, also, that having no other use for their fore-feet than to support their bodies, they have no occasion for a powerfully-framed shoulder; whence we infer, what is the case, the absence of the clavicle and acromion, and the straightness of the scapula. Not having any occasion to turn their fore-legs, their radius will be solidly united to the ulna, or, at least, articulated by a hinge-joint, and not by ball and socket, with the humerus. Their herbivorous diet will require teeth with a broad surface to crush seeds and herbs. This breadth must be irregular, and for this reason the enamel parts must alternate with the osseous parts. This sort of surface compelling horizontal motion for grinding the food to pieces, the articulation of the jaw cannot form a hinge so close as in carnivorous animals. It must be flattened, and correspond with the facing of the temporal bones. The temporal cavity, which will only contain a very small muscle, will be small and shallow," &c. (§ 169, *f*).

324. An intestine, claw, tooth, hoof, or other bone, therefore, of an unknown animal being given, we may construct a skeleton that shall be nearly true to nature in all its parts. We may then proceed to cover it with muscles; and, lastly, we can tell from that tusk, or claw, or hoof, or other bone, what was the structure of the digestive apparatus, and to what kind of food the gastric juice was specifically adapted, and what were the peculiar instinct and habits of the animal,—so special is the adaptation of all other parts of the organization, both in animal and organic life, and all the habits and instincts of animals, to the peculiarities of the digestive organs in every species (§ 18).

325. Now the whole of the foregoing mutual concurrence of all parts of the body, the adaptation of each part to the others in structure and use, being directly designed to subserve the purposes of digestion, and since it cannot be seriously entertained that any physical or chemical force is concerned in such a labyrinth of harmonious structure and actions, and so distinguished throughout by a multitude of the most consummate Designs, and all conspiring to one common end, it is manifestly absurd to imagine that *digestion, the final cause of the*

whole, is carried on by agencies which have no connection with the various subordinate means (§ 14, 74, 80, 117, 129 *i*, 133–137, 143, 155, 156, 169 *f*, 266, 303¼ *a*, 306, 318, 336, 387, 399, 422, 514 *h*, 524 *d*, 525, 526 *d*, 528 *c*, 638, 649 *d*, 733 *b*, 764 *b*, 811, 847 *c*, 848, 902 *f*, 905).

326. What we have now seen of fundamental Design in the construction and subservience of all parts to the function of assimilation, and of the exact concurrence of the whole toward the incipient step, may well prepare the mind to realize the same Design throughout the whole system of organic processes, the same exact foundation in anatomical structure, and in vital properties, the same precise and everlasting laws (§ 169, *f*). Do we look again, therefore, at the stupendous fabric upon which, and its special vital endowments, the laws of sympathy depend? Astonishment abates, and unbelief yields as well to the force of analogy as to direct demonstration.

327. The philosophy of assimilation applied pathologically, and in conformity with the doctrines of solidism, is the following: The function of assimilation, being performed by the organic properties through their media of action, there will be a corresponding change in the elementary combination of the new compounds which are added to the parts affected, and the same morbid condition of the vital properties will be imparted to the new compounds.

328. If the stomach be diseased, then the nature of the gastric juice will be altered according to the manner in which the properties of the stomach may be affected. If, also, we allow, in this case, that the chyme will have a corresponding variation, and that this will in itself affect the whole character of the circulating mass of blood, so that the new elementary combinations, those of the solids and secreted fluids, will be more or less modified in all parts, we shall in no respect compromit the consistency of nature, or the fundamental principles of physiology (§ 44, 52, 78, 153–155, 218–220). However such admission may look like humoralism, it has no affinity with it. The whole process resolves itself into a primary disease of the solids; and the modified condition of the blood, which I am now supposing, does not derange the vital properties and actions of the system (§ 156 *b*, 845, &c.). But when chylification is affected by diseased states of the stomach, reflex nervous actions are then so exerted by that organ upon other parts, that their vital states do actually sustain a change, and often a far greater one, from that sympathetic cause. This more general modified condition of the solids contributes still farther to modify the new combinations, and to give rise to what are called vitiated secretions. The most striking examples are seen, of course, when digestion fails altogether, and the solids become universally affected by disease, as in fever (§ 143 *c*, 148, 657 *b*, 776, &c.).

329. If the heart and vascular system at large feel, mainly, the influence of gastric or some other local disease, the blood is always more or less affected in its composition, and assimilation is otherwise variously modified in all other parts, not only in consequence of the change in the blood, but of the affection of all the organs and fluids which are concerned in assimilation. Nothing affects the composition of the blood so rapidly as disturbances of the vital conditions of the heart and blood-vessels; or, perhaps, I should rather say of the extreme capillary blood-vessels. Nothing can prove more distinctly the truth of solidism and the fallacies of humoralism; especially those

more instantaneous changes which are effected in the entire circulating mass of blood by abstracting only an ounce of it from the arm (§ 845, &c., 952).

330. Now, suppose, instead of treating disease upon some broad principles, we were to undertake the specific object of the humoralists in any of the foregoing cases (§ 327–329); that is to say, the restoration of the blood in its composition and nature. The humoral pathologist would attempt its *direct* medication, in the vain hope that his drugs can produce, by their direct action upon the fluid, that natural combination of its elements, and that natural state of its vital properties, for doing which Nature has provided the whole system of the great vital organs, and many living secretions (§ 845, &c.). Since, therefore, the humoralist has not a physiological principle for his government, he has departed wholly from nature. The duty of cure thus devolves upon the solidist, who proceeds to restore assimilation by re-establishing the natural condition of the various tissues and organs whose functions had become deranged and had been the cause of the altered condition of the blood; and this is effected according to the manner set forth in my chapter on the *modus operandi* of remedial agents. There, too, you shall find, as well as in my disquisitions upon the philosophy of solidism, that the living solids are the only agents which can possibly effect any salutary changes in the *pabulum vitæ*, and, therefore, that when the former are diseased along with the latter, they must take the initiating step both in the morbid and healthy processes. Just in proportion, therefore, as the solidist improves the condition of the diseased organs, assimilation will approximate its natural state, and the blood be regenerated according to established physiological laws.—Note R p. 1123.

331. The condition, therefore, of the blood and of the products elaborated from it, in all cases of disease, should be regarded only as more or less significant of the morbid changes which may affect the solid parts.

332. Having now gone over the general philosophy relative to assimilation, I shall proceed to consider its principal element, or what is denominated

THE PHYSIOLOGY OF DIGESTION.

In my investigation of this subject I shall enter rather extensively upon the ground of *Organic Chemistry*, in all its applications to the science of medicine; since it is here, especially, as said in the Commentaries, that chemistry has reared its batteries, and from whence it sends forth its artillery into the various dominions of organic life. A contrast will be instituted under the general designations of Physiology and Organic Chemistry, in their relation to healthy and morbid processes.

333. The doctrines of life, as hitherto expounded, should be applicable to all the problems in organic beings which may seem to a superficial observer to fall under the laws of chemistry, or of physics. Such problems are especially presented by digestion, respiration, and the production of organic heat; and these are the main intrenchments of chemistry. If the philosophy, therefore, which I have thus far propounded lie at the foundation of the foregoing results, it is probable that chemistry must be abortive in facts, and wild in conclusions; and

the more so as it advances to the greater obscurities in physiology, pathology, and therapeutics. Such are the realities; and their exposure is the overthrow and the perpetual doom of organic chemistry.

334. Human physiology has been greatly vitiated, in recent times, by experiments upon animals, and conducted under the most unnatural circumstances. They have been extensively made, in a physiological aspect, without any view to the differences in organization and vital constitution between animals and man, and often with a reference to more functions than belong to any organic being. When prompted by pathological and therapeutical considerations the experiments have been liable not only to the foregoing objections, but to the greater one of assuming that there is no difference in the susceptibility of organs to the action of natural, morbific, and remedial agents in the varying states of health and disease (§ 149, 150, 240). These experimental fallacies, and the vast errors to which they have led and are still leading, I have considered extensively in my Essay on the Humoral Pathology.—*See* p. 839, § 1058 *b*, *note*.

In a physiological sense, the greatest evil attending the foregoing experiments consists in neglecting the fact that the constitution of man is different from that of animals when applying the results of such otherwise unnatural experiments to explain the vital laws which govern the functions of the human species.

The disparity increases between the natural laws and results of the human and those of vegetable organization, and others, again, of chemical affinities, just in the ratio of the difference between the varieties of organization and vital constitution, and the attributes of the inorganic kingdom.

335. What, then, shall be said of those experiments which are conducted in the laboratory of the chemist to determine the physiology of the highest function of life, but in which organization takes no part, and the whole process is carried on by artificial "mixtures" and chemical reagents? This is now the almost universal philosophy, and therefore demands an investigation which shall lead either to its confirmation or to its overthrow (RIGHTS OF AUTHORS, p. 912).

336. It is in the stomach that vitality is exemplified in its most impressive and astonishing aspects, and where unequivocal demonstrations abound that fluids, as well as solids, are endowed with the principle of vital operations, "a principle distinct from all other powers of nature" (§ 64, 339). It is here, especially, that nature has illustrated her distinction between the animate and inanimate world, and established her chain of connection. It is here, in the incipient change of dead into living matter, that we witness a full display of those powers which operate in the most elaborate organization, and an equal exclusion of the forces which appertain to dead matter. It is here the line of separation begins abruptly; but where analogies are presented in the conversion of dead into living matter, through new modes of combining the same elements; and admiration increases, as we mount along the entire function of assimilation, and find, at each step of the ascending series, that the whole agency is committed to forces that have no existence in the inorganic world; that the whole is the harmonious result of a principle which may form an intermediate link between spirit and matter; and that there is no power within our control by which we can determine the nature of the changes.

Casting a glance at the vegetable world, we find the connection continued, by other analogous links, with elementary matter itself; but here, as in the higher department of nature, the line of separation is equally defined, however low in the scale of analogy may be the properties of life which have their beginning in vegetable organization.

It is here, then, at the threshold of life, as in the propagation of the species, that we especially witness a substitution for Creative Power; and, as all that appertains exclusively to the organic world was perfectly distinct in its Creation from the inorganic, so are the substituted processes of generation, and of the conversion of dead into living matter, equally distinct from the causes and results of inorganic processes (§ 32, &c., 63, &c.).

For conducting that connected series of changes which make up the process of assimilation in animals, a complex apparatus has been provided, whose beginning in the vegetable kingdom, and whose progressive development in the higher kingdom, have been contrived upon consummate principles of Design, that the elements of matter shall be gradually brought into those perfectly new conditions, both as to composition and properties, which contradistinguish the organic from the inorganic kingdom, and thus as in all things else in the natural world, that abrupt transmutation of inorganic into organic matter which distinguished the Creative Act shall be avoided, and remain a characteristic of Creative Power (§ 14, 172, 325).

337. In the early part of this work, I set forth some general facts which evince an incongruity of doctrines that clearly divides the physiological world into three schools; one of them (pure chemistry) making no distinction between the properties and laws of organic and inorganic beings; a second (pure vitalism) contradistinguishing the two kingdoms in those fundamental conditions; and the third (chemico-vitalism) blending the doctrines of chemistry and vitalism (§ 4½, 820 *c*). Each of these denominations has interpreted the philosophy of digestion according to the general doctrines of life which are peculiar to each.

338. Beginning with pure chemistry, we find the great leader setting forth the process of digestion in the following language in his late work on *Animal Chemistry applied to Pathology and Therapeutics*.

"CHYMIFICATION," he says, "IS INDEPENDENT OF THE VITAL FORCE. It takes place in virtue of A PURELY CHEMICAL ACTION,—EXACTLY SIMILAR to those processes of decomposition and transformation which are known as PUTREFACTION, FERMENTATION, OR DECAY" (§ 365).

It will be also seen from the foregoing quotation, that the chemist is regardless of his own rules of philosophy, and of the fundamental principles of chemistry; since he identifies the organizing act, or that which combines the elements of matter into complex organic compounds, with the chemical process that resolves these compounds into their ultimate elements. We are told, indeed, that this is "experimental philosophy," and that, therefore, we must submit to it (§ 350).

339, *a*. I shall now set forth the exact doctrine of the vitalists relative to the physiology of digestion, in the language of the same distinguished "reformer" whom I have quoted in the preceding section. It is true, the doctrines are as fundamentally opposed as contradiction can possibly make them. But, as will have been abundantly seen, the most remarkable characteristic of the writings of this distinguished

man are their palpable contradictions. Nor can there be any proof so conclusive of the radical distinction between the philosophy of life and the philosophy of chemistry, about which "the reformer" was simultaneously concerned.

But, I will go back for a conflicting doctrine to the treatise "*on Organic Chemistry applied to Physiology*," published a year or two antecedently to his work "*on Animal Chemistry*;" by which we shall learn the extent of the confusion which pervades his writings, and the tardiness with which it is discerned by his medical disciples. In that work he says,

"The equilibrium in the chemical attractions of the constituents of food is disturbed BY THE VITAL PRINCIPLE. The UNION OF ITS ELEMENTS, so as to produce NEW COMBINATIONS AND FORMS, indicates the presence of A PECULIAR MODE OF ATTRACTION, *and the existence of* A POWER DISTINCT FROM ALL OTHER POWERS OF NATURE, namely, THE VITAL PRINCIPLE." "If the food possessed life, not merely the chemical forces, but THIS VITALITY would offer resistance to the *vital force* of the organism it nourished."—LIEBIG.

Such, then, is exactly the doctrine of the vitalist and solidist, mistaken by the chemist for his own, when he happened to be reasoning according to the promptings of organic nature. The same views are presented in the work on *Animal Chemistry* (§ 350).

339, *b*. And here, perhaps, it may be worth our while to say that the resuscitated chemical doctrine (§ 338) is apparently too wide a departure from fact even for that part of the British medical profession who have received most of the sayings of Liebig as oracular revelations; for we read in the late edition of the "*Pharmacologia*," now devoted to the authorized philosophy (§ 349 *d*, 676 *b*), that,

"According to the experiments of Spallanzani, and still more recently of Dr. Beaumont, if, after putrefaction has actually advanced, a substance in such a condition be introduced into the living stomach, the process is immediately checked, *and no signs of putrefaction are presented by the digested food*, although were the same substances left at the temperature of 99° F., they would soon evince evidence of its progress. It is therefore clear that the VITAL POWERS of the digestive organs must, in such cases, reverse or suspend the ordinary chemical affinities" (§ 676, *b*).—PARIS's *Pharmacologia*, p. 148. *London*, 1843. And such, in reality, is one of Liebig's conflicting statements.

And why should not the "vital powers reverse or suspend the ordinary chemical affinities" in all other cases of food, where it is far more obvious that such resistance does happen; and why may we not conclude that the law in relation to digestion has a wide foundation in living beings? Why does not the blood putrefy? Why not any other animal or vegetable fluid? Why not any living animal or vegetable solid?

340. Let us now hear the student of organic nature upon the physiology of digestion. What says John Hunter, of whom it is said by one, that "he stands alone in our profession;" that, "in his immense career, every thing bore reference to one great idea,—*the discovery and elucidation of nature's laws*;" "who," says another, "was neither anatomist, physiologist, surgeon, nor naturalist, alone, but the most remarkable combination of all these which the world has yet seen;"

for, "where," says another, "in the calendar of time, shall we look for an equal in the compass, the variety, and the depth of his researches into the mysteries of animal life, or for consequences such as those that have resulted from his labors to universal pathology;" while another apostrophizes, "how humble do any of the men of the present day appear when placed by the side of Hunter!" "The genius of Hunter," says another, "long ago explained the objections to other theories of digestion. These have been turned into ridicule to smooth the way for hypotheses that have no better foundation."

Well may we ask, what says John Hunter on the physiology of digestion?

"Digestion," he says, "is an assimilating process. It is a species of generation; but the curious circumstance is its converting both vegetable and animal matter into the same kind of substance or compound, which no chemical process can effect. Those who took it up *chemically, being ignorant of the principles of the animal economy*, have erroneously referred the operations of the animal machine to the laws of chemistry."

341. The illustrious George Fordyce, after a thorough experimental investigation of the subject, comes to the conclusion that,

"The changes which take place in the substances capable of giving nourishment, and, therefore, of being converted into the essential parts of the chyle, are TOTALLY DIFFERENT from those changes which take place any where but in the stomach, duodenum, and jejunum, *when alive.* Therefore, *no experiment made any where*, EXCEPTING IN THESE INTESTINES OF THE LIVING ANIMAL, *can in the smallest degree influence* the doctrine of digestion." "Food placed in all the chemical circumstances that can be conceived similar to those in which it is placed in the living animal, will never be converted into chyme, but will undergo other changes totally different." He finally adds, as the result of his own experiments out of the stomach, that, "*whether we employ the gastric juice, or bile, or saliva, in no case has* CHYLE, OR ANY THING LIKE IT, EVER BEEN PRODUCED." The reason is, that the gastric juice, like the blood, loses its vitality as soon as abstracted from the stomach. Hunter arrived at exactly the same conclusion from his observations (§ 364).

342. It is the opinion of Tiedemann, another distinguished inquirer into the nature of digestion (§ 340, 341), that,

"All the phenomena of digestion and assimilation, and which are only observed in living bodies, appear to rest, as to their foundation, on the VITAL PROPERTY which *organized liquids* possess of producing, under certain circumstances, in other organic matters, similar changes that cause these bodies to acquire the properties themselves are endowed withal." Again:

"It cannot be mistaken that digestion is an operation exclusively the property of living bodies, and *is in no way to be compared* with the changes of composition which general physical forces and the play of chemical are capable of producing in inorganic matters. It must be considered as a vital act, as an effect of life."

As to assimilation by vegetables, Tiedemann holds the same doctrine as Hunter, Fordyce, and all other physiologists whose opinions have survived the day on which they were promulgated. Thus:

"On the subject of the material changes which vegetable parts un-

dergo in nutrition, chemistry has hitherto given us no satisfactory information, simply because, *being effects of life, such changes are beyond the domain of chemical science.* All that we are authorized to admit is, that the changes of composition that occur during the nutrition of vegetables are the consequence of vital manifestations of activity, and not the effects of chemical affinities, such as are observed in inorganic bodies."

"All the attempts," he goes on, "of the iatro-mechanicians and iatro-chemists to reach this point (assimilation) have failed; and it is well ascertained that such ideas are both unsatisfactory and erroneous. We are therefore under the necessity of regarding them as effects, *sui generis*, as vital manifestations, founded on a power peculiar to, and inherent in, organic bodies."—TIEDEMANN'S *Physiology.*

343. Turning to the greatest of French physiologists, we hear from him the same general protest against the corruption of medicine by ingrafting upon it the physical sciences (§ 5½, *b*).

344. In considering farther the physiology of digestion, I shall introduce, in the first place, a series of general conclusions which have been derived from chemistry, both as to digestion and other organic processes, and when in this respect and otherwise prepared, I shall state the remaining grounds upon which I rely more specifically for establishing the vital doctrine.

345. Let us hear, then, the distinguished chemist, Dr. Prout, as the representative of those who mingle chemistry with vitalism.

"First," says Dr. Prout, "the stomach has the power of dissolving alimentary substances, or, at least, of bringing them to a semi-fluid state. This operation seems to be *altogether chemical.*

"2d. The stomach has, within certain limits, the power of changing into one another the simple alimentary principles," and "this part of the operation of the stomach appears, like the reducing process, to be *chemical;* but not so easy of accomplishment. It may be termed the converting operation of the stomach.

"3d. The stomach must have, within certain limits, the power of *organizing and vitalizing* the different alimentary substances." "It is *impossible to imagine* that this organizing agency of the stomach can be chemical. *Its agency is vital,* and its nature completely unknown."

346. Such, then, is the doctrine of digestion as entertained by the chemico-vitalist (§ 345). But, from what we shall have seen of the absolute contradictions which abound in the writings of those who attempt the application of pure chemistry to the functions and results of organic life, we may expect that the chemico-vitalist will be equally inconsistent when he applies himself, at one time, to the phenomena of living beings, and, at another, reasons from the results of the laboratory to those phenomena. Accordingly, we find within a few pages of the foregoing doctrine of the chemico-physiologist, that he broadly affirms that

"There is NO RELATION WHATEVER between the MECHANICAL arrangements and the CHEMICAL properties to which they administer." "There is NO REASON why the chemical changes of organization should result from the mechanical arrangements by which they are accomplished; neither is there the SLIGHTEST REASON, why the mechanical arrangements in the formation of organized beings should lead to the chemical changes of which they are the instruments"!

Here, then, in a single sentence, are not only the strangest contradictions, but a full admission that there is not the "slightest reason" for the application of chemistry to any process, function, or result of living beings.

347. Nor is that all. For the chemico-vitalist, the same eminent chemist whom I have just quoted, goes on to say, that "with the living, the animative properties of organic bodies, *chemistry has not the smallest alliance, and probably will never*, IN ANY DEGREE, *elucidate those properties*. The phenomena of life are not even REMOTELY ANALOGOUS to any thing we know in chemistry as exhibited among inorganic agents." And, as if to complete the overthrow of the chemical part of the philosophy of digestion, the same reasoner observes that, "the MEANS by which the peculiarities of composition and structure are produced, which is so remarkable in all organic substances, like the RESULTS themselves, are QUITE PECULIAR, and bear little or no resemblance to *any artificial process of chemistry*;" that "those who have attempted to apply chemistry to physiology and pathology *have split on a fatal rock* by hastily assuming that what they found by experiment to be wanting, or otherwise changed, in the animal economy, was the cause of particular diseases, and that such diseases were to be cured by supplying, and adjusting artificially, the principle in error. But the scientific physician will soon discover that Nature will not allow him to officiate as her journeyman, even in the *most trifling degree*."—DR. PROUT'S *Bridgewater Treatise*.

348. And, to the same effect may be quoted Dr. Carpenter, one of the foremost, as we have seen, in the school of pure chemistry (§ 64, *g*).

"The agency of VITALITY," says this reasoner, in his Comparative Physiology, where he generally ridicules the term and all that is relative to it, "*the agency of* VITALITY, as Dr. Prout justly remarks, does not change the properties of the elements, but simply COMBINES THE ELEMENTS *in modes which we cannot imitate*"!

So, also, Dr. Roget, alike distinguished in the school of chemico-vitalism (§ 64, *f*): "VITAL *chemistry*," he says, "*is* TOO SUBTLE A POWER *for human science to detect, or for human art to imitate*."

And thus the eminent Wagner, not less arrayed on the side of chemistry:

"The existence of one or more powers, commonly called VITAL powers, is not, however, denied. The FINAL CAUSE of the secretion of the gastric juice LIES IN THE NATURE OF THE ANIMAL ORGANISM, and is UNKNOWN to us."—WAGNER'S *Physiology, London*, 1842, p. 346. And yet this distinguished observer is one of the manufacturers of gastric juice.

349, *a*. Thus might I go on with one after another, till I should have exhausted the whole that have attempted to confound the science of life with the science of chemistry, and prove by their own statements that there is not the slightest intelligible connection between them. Indeed, I have already, in the Medical and Physiological Commentaries, pointed out this universal admission (§ 626 *b*).

The ground of chemistry being thus virtually abandoned to the vitalist, it would seem superfluous to pursue an adversary who is always upon the retreat. But, as he flies, he is forever shooting from behind, and his Parthian weapons fall thickly and heavily upon the vast multitude. He must therefore be subdued into a practical acqui-

escence with those consistent principles of nature which exact his consent, but not his compliance.

349, *b*. Perhaps no author has supplied so many examples of contradictions in great fundamental principles, and in so small a compass, as he who has so lately taken captive the physiological world. In the Preface to the Essays "*On the Philosophy of Vitality and the Modus Operandi of Remedial Agents*" I had occasion to say of the article on "Poisons, Contagions, and Miasma," in LIEBIG'S "*Organic Chemistry applied to Agriculture and Physiology*," that "it is certainly the most stupendous exhibition of perverted facts, of combinations of conflicting doctrines, and of the rudest system of pathology and therapeutics, that can be found in the records of dreamy speculation."

It was objected by the editor of the *London Lancet*, that I did not prove my allegations (§ 5½, *a*). Nor was it in any respect the object of that work to do so. I was satisfied with calling attention to the facts, and with what I had already published in the Medical and Physiological Commentaries. Since that day, the work on "*Animal Chemistry*" has appeared; and it is now my purpose to sustain the allegations of the "Preface," and this more especially from the objections alleged by Liebig against physiologists (§ 350, *mottoes*, *a*, *b*, *c*, and *d*).

I say, therefore, that we meet on the same page a purely chemical and a purely vital philosophy of digestion; and equally so of other important organic processes. That each is laid down without qualification, and with the *dictum* of a master, who is conscious that the preponderance he gives to the purely chemical philosophy of life will establish his Empire in that philosophy with an age more prone than ever to the doctrines of materialism.

349, *c*. Let us, therefore, not be deceived; for, however this very extraordinary and successful pretender in medicine may beguile us with words, and seem to persuade rather than to rule, let us remember that, at most, he does but invalidate his own edicts by countermands, and that in the end he tells us that these apparently adverse decrees are, in their absolute import, one and the same; that they are consistent laws delivered from the laboratory, though apparently in conflict on account of the opposing forces, the attraction and repulsion, which preside in the chemistry of nature; that, however, in reality, there is no difference whatever in the seemingly two great principles which lie at the foundation, which are one and identical, since "*the mysterious vital principle can be replaced by the chemical forces;*" and since, also, "*the vital force unites in its manifestations all the peculiarities of the chemical forces, and of the no less wonderful cause which we regard as the ultimate origin of electrical phenomena.*" And again, "*in the processes of nutrition and reproduction, the ultimate cause of the different conditions of the vital force are chemical forces*" (§ 64, *e*). —LIEBIG'S *Organic Chemistry;* and *Animal Chemistry*.

349, *d*. It is painful to speak thus of one so highly endowed, so devoted in mind, so accomplished in chemistry; but science and humanity demand the sacrifice. But, again, I wish to be understood, that neither here, nor in any other case, is it the individual of whom I speak, but of his doctrines alone (§ 1 *b*, 4 *b*). Nor yet would the doctrines of an individual become the subject of extended remark, did they not represent the existing state of the three high branches of medicine. The gigantic physical school had too much of the Pro-

lean character, too little unity of purpose, and demanded greater stability. The learned men of a great Nation, *The British Association for the Advancement of Science*, united in the object, and bestowed the honor of achieving the enterprise upon a foreign Chemist. The note of proscription has been sounded in high quarters, in due conformity (§ 5½ *a*, 350¾ *kk*), and medical philosophy has nothing to hope even from a spirit of toleration. The subject, therefore, must be brought to the test of observation and reason, and he who arraigns the authorized doctrines will cheerfully abide an unsuccessful issue (§ 1 *b*, 676 *b*, 709, *note*). I shall therefore dwell upon the conclusions of those who have engendered the corruptions, and shall array them in all the force demanded by the magnitude of my subject, that we may the better realize the shallowness of that pretended philosophy which has so lately swept, like a hurricane, over the intellectual world, that we may see, in the system of contradictions, the equal fallacy of that school who endeavor, with great sincerity, to mingle the conflicting principles, and that we may the better cultivate and enjoy the simple and consistent philosophy which nature teaches. Nor will I yet leave this general reference to that stupendous system of assumption and contradiction which was so lately hailed by physiologists as the harbinger of a total revolution in medical science, ay, in the very practice of medicine, without showing you the depth of the materialism in which it was founded. I say nothing now of the avowed infidelity to which it has led. Examples of that disregard of instinctive faith I have already placed in their proper connection with my subject.* But, I will merely present, in relief, from Liebig's revolutionary work, a doctrine of the chemical school, from which, if I mistake not the ambition of intellectual and immortal beings, the very impulse of nature will turn the most indifferent with a loathing aversion. We shall see from it, also, how entirely degraded to the rank of the merest matter is every thing relating to organic life; even man himself. Thus, then, "the Reformer," in behalf of the school of chemistry:

349, *e*. "Physiology has sufficiently decisive grounds for the opinion that *every motion, every manifestation of force*, is the RESULT of a transformation of the structure or of its substance; that every conception, every mental affection, is followed by changes in the chemical nature of the secreted fluids; that every thought, every sensation, is accompanied by A CHANGE IN THE COMPOSITION OF THE SUBSTANCE OF THE BRAIN." "*Every manifestation of force is the* RESULT *of a transformation of the structure or of its substance.*"—*See* p. 158, no. 5½.

And now may it not be reasonably asked, what is the cause of those chemical changes in the cerebral substance which give rise to "every conception, every mental affection, every thought, and every sensation" (§ 175 *c*, 500 *n*, 1054, 1076 *a*) those "*manifestations* of force"?

Many organic chemists, however, are disposed to admit a spiritual part, and they should therefore recollect that the existence of a principle of life is not less substantiated by facts than the existence of the soul, which they are so ready to concede when inviting our attention to the physical doctrines of life.

350. I have just said that I would present such an array of contra-

* See *Medical and Physiological Commentaries*, vol. ii., p. 122–140. Also, the *Essay on the Vital Powers*, in vol. i. Also TACITUS' *Dialogue Concerning Oratory*.

dictory opinions on the physiology of digestion, and the general philosophy of life and disease, from the two brief National Essays by Liebig (§ 349, *b*), as should induce physiologists to retrace their steps, and thus make some atonement to the science which was surrendered with an acclamation that had been worthy the original institution of medicine.

In the first place, however, with a view to the cause which I advocate, and in justice, also, to able and independent philosophers, I shall quote the following remarks from a letter addressed to myself by a distinguished writer, of Manchester (England):

"Manchester, May 5, 1846.

"DEAR SIR,

"*I made your pamphlet* (a Lecture on Digestion) *the subject of a Paper which I read before the* MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY, *and which provoked a discussion two nights. The result was almost unanimously in favor of your views in reference to the Philosophy of Digestion. I am*, &c.,

"CHARLES CLAY, M.D."

I shall now exhibit, in parallel columns, the new philosophy which forms the present science of medicine, preceded by some appropriate *mottoes*.

a. "ANIMAL and VEGETABLE physiologists institute experiments without being acquainted with the circumstances necessary to the continuance of life—with the qualities and proper nourishment of the animal or plant on which they operate—or with the nature and chemical constitution of its organs. These experiments are considered by them as convincing proofs, while they are fitted only to awaken pity" (no. 50).

b. "ALL DISCOVERIES in physics and in CHEMISTRY, all explanations of CHEMISTS [!] must remain without fruit and useless, because even to the GREAT LEADERS IN PHYSIOLOGY, carbonic acid, ammonia, acids, and bases, are sounds without meaning, words without sense, terms of an unknown language, which awaken no thoughts, and no associations. They treat these sciences like the vulgar, who despise a foreign literature in exact proportion to their ignorance of it."—LIEBIG'S *Organic Chemistry applied to Physiology*, &c. [See no. 2.]—(§ 1034).

c. "None of them (the most distinguished physiologists) had a clear conception of the process of development and nutrition, or of the true cause of death. They professed to explain the most obscure *psychological* phenomena, and yet they were unable to say what fever is, and in what way quinine acts in curing it" (no. 2, 42). The oft-reiterated conclusion follows, that IT IS RESERVED FOR CHEMISTRY TO RESOLVE THESE PROBLEMS.

d. "Thus *medicine*, after the fashion of the Aristotelian philosophy, has formed certain conceptions in regard to NUTRITION and SANGUIFICATION. *Articles of diet* have been divided into NUTRITIOUS and NON-NUTRITIOUS; but these THEORIES [!] being founded on observations DESTITUTE of the conditions most essential to the drawing of just conclusions, could not be received as expressions of the truth. How clear are now to us the relations of the different articles of food to the objects which they serve in the body, since *organic chemistry* has applied to the investigation her quantative method of research"! (§ 18, 409.)

e. "The limited acquaintance of physiologists with the methods of research employed in chemistry WILL CONTINUE TO BE the chief impediment to the progress of physiology, as well as a reproach which that science cannot escape."—LIEBIG'S *Animal Chemistry*.

f. "What has the SOUL, what have consciousness and intellect to do with the development of the human fœtus, or the fœtus in a fowl's egg? Not more, surely, than with the development of the seeds of a plant. Let us first endeavor to refer to their ultimate causes those phenomena of life which are not psychological; and *let us beware of drawing conclusions before we have a ground-work*. We know exactly the mechanism of the eye; but neither anatomy nor CHEMISTRY will ever explain how the rays of light act on consciousness, so as to produce vision. Natural science has fixed limits which cannot be passed, and it must always be borne in mind that, with all our discoveries, we shall never know what light, electricity, and magnetism are in their essence, because, even of those things which are material, the human intellect has only conceptions. We can ascertain, however, the laws which regulate their motion and rest, because these are manifested in phenomena. IN LIKE MANNER, THE LAWS OF VITALITY, AND OF ALL THAT DISTURBS, PROMOTES, OR ALTERS VITALITY, may certainly be discovered, although we shall never learn what life is" (§ 168). — LIEBIG'S *Animal Chemistry*.

g. "For years past a tribunal has been established at Giessen, before which Liebig is at the same time accuser, witness, public prosecutor, advocate, and judge."—MÜLDER'S *Reply to Liebig. Translation*, London, 1846.

h. "Chemists and natural philosophers, accustomed to study the phenomena over which the physical forces preside, have carried their spirit of calculation into the theories of the vital laws."—BICHAT'S *General Anatomy*, vol. ii., p. 54.

i. "Let a man be given up to the contemplation of one sort of knowledge, and that will become every thing. The mind will take such a tincture from a familiarity with that object, that every thing else, how remote soever, will be brought under the same view. A metaphysician will bring ploughing and gardening immediately to abstract notions; the history of nature will signify nothing to him. A chemist, on the contrary, shall reduce divinity to the maxims of his laboratory, explain morality by *sal*, *sulphur*, and *mercury* and allegorize the Scripture itself, and the sacred mysteries thereof, into the philosopher's stone."—LOCKE, *on the Human Understanding*.

k. "Mr. Locke, I think, mentions an eminent musician, who believed that God created the world in six days, and rested on the seventh, because there are but seven notes in music. I myself knew one of that profession who thought there were only three parts in harmony, to wit, base, tenor, and treble, because there are but three persons in the Trinity."—REID, *on the Powers of the Human Mind*, vol. ii., *Essay* 6, c. viii.

l. "When education takes in error as a part of its system, there is no doubt that it will operate with abundant energy, and to an extent indefinite" (§ 433).—BURKE.

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1. "MY OBJECT has been, in the present work, to direct attention to the points of intersection of *chemistry with physiology*, and to point out those parts in which the sciences become, as it were, *mixed up together*. It contains a collection of problems, such as *chemistry* at present requires to be resolved, and a number of conclusions drawn *according to the rules* of that science. These questions and problems will be resolved; and we cannot doubt that we shall have in that case A NEW PHYSIOLOGY AND A RATIONAL PATHOLOGY."—LIEBIG'S *Animal Chemistry*.

2. "In *earlier times*, the attempt has been made, and OFTEN WITH GREAT SUCCESS, to apply to the objects of the *medical* art the views derived from an acquaintance with *chemical* observations. Indeed, the great PHYSICIANS, who lived toward the end of the 17th century, were the FOUNDERS OF CHEMISTRY, AND IN THOSE DAYS THE ONLY PHILOSOPHERS ACQUAINTED WITH IT."—LIEBIG'S *Animal Chemistry*. (See mottoes *b*, *e*.)

3. "In the *animal body* we recognize as the ultimate *cause of all*

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47. "A RATIONAL physiology cannot be founded on mere reactions, and the living body cannot be viewed AS A CHEMICAL LABORATORY."

"The study of the USES of the functions of different organs, and of their MUTUAL CONNECTION in the animal body, was formerly the chief object in physiological researches; but lately THIS STUDY has fallen into the back-ground."—LIEBIG'S *Animal Chemistry*.—(See motto *c*.)

48. "WITH ALL ITS DISCOVERIES, *Modern Chemistry* has performed but SLENDER SERVICES to physiology and pathology."—LIEBIG, *ibid.*

49. "*Physiology* still endeavors to apply *chemical experiments* to the removal of diseased conditions; but, with all these COUNTLESS EXPERIMENTS, we are not ONE STEP NEARER to the *causes and essence of disease*."—LIEBIG, *ibid.*

50. "Mechanical philosophers and CHEMISTS *justly* ascribe to THEIR methods of research the greater part of the success which has attended their labors."—LIEBIG'S *Animal Chemistry* (*a*).

51. "In the *animal ovum*, as well as in THE SEED OF A PLANT,

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force only *one cause*, the CHEMICAL ACTION which the elements of the food and the oxygen of the air mutually exercise on each other. The only known ultimate *cause* of vital force, either in animals or in plants, is A CHEMICAL PROCESS. If THIS be *prevented*, THE PHENOMENA OF LIFE DO NOT MANIFEST THEMSELVES. If the *chemical action* be *impeded*, the vital phenomena must take *new forms*." "ALL VITAL ACTIVITY ARISES from the mutual action of the oxygen of the atmosphere and the elements of the food."—LIEBIG'S *Animal Chemistry*.

4. "THE LIFE of animals exhibits itself in the continual absorption of the oxygen of the air, and its combination with certain parts of the animal body."—LIEBIG'S *Animal Chemistry*.

5. "Physiology has sufficiently decisive grounds for the opinion, that EVERY MOTION, EVERY MANIFESTATION OF FORCE, IS THE RESULT OF A TRANSFORMATION OF THE STRUCTURE OR OF ITS SUBSTANCE; that *every conception, every mental affection*, is followed by *changes* in the chemical nature of the secreted fluids; that *every thought, every sensation*, is accompanied by a change in the *composition* of the substance of the brain"! —LIEBIG'S *Animal Chemistry* (no. 41, 18½).

5½. That our Author's intent cannot be doubtful appears from his *unequivocal* statement that— "The higher phenomena of mental existence cannot, in the present state of science, be referred to their proximate, and still less to their ultimate causes. [*Of course, therefore, not to a Soul.*]. We only know of them that they exist." Again—"The efforts of philosophers, constantly made to penetrate the relations of the soul to

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we recognize A CERTAIN REMARKABLE FORCE, THE SOURCE OF GROWTH, or increase in the mass, and of reproduction, or of supply of the matter consumed; A FORCE IN A STATE OF REST. By the action of external influences, by impregnation, by the presence of air and moisture, the condition of STATIC EQUILIBRIUM of this force is disturbed. ENTERING INTO A STATE OF MOTION OR ACTIVITY, *it exhibits itself* IN THE PRODUCTION *of a series of forms*, which, although occasionally bounded by right lines, are yet widely distinct from geometrical forms, such as we observe in crystalized minerals. This force is called THE VITAL FORCE, *vis vitæ*, or VITALITY." "The *increase* of mass is effected in living parts by the VITAL FORCE."—LIEBIG'S *Animal Chemistry*. (See my *Essays on Vitality*, &c., p. 13–18.)

51½. "The OXYGEN of the atmosphere is the proper, active, external cause of the WASTE of matter in the animal body. It acts like a force which tends to disturb and DESTROY the manifestations of the VITAL FORCE at every moment. But its effect as a chemical agent (in producing *waste*), the disturbance proceeding from it, IS HELD IN EQUILIBRIUM BY THE VITAL FORCE."—LIEBIG'S *Animal Chemistry*.

52. "The vital force is manifested in the form of RESISTANCE, inasmuch as by its presence in the living tissues *their elements acquire the power of withstanding the disturbance and change in their form and* COMPOSITION which external agencies tend to produce: A POWER which, as CHEMICAL COMPOUNDS, THEY DO NOT POSSESS." —LIEBIG'S *Animal Chemistry*.

53. "The VITAL PRINCIPLE must be a MOTIVE POWER, CAPABLE OF

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animal life, have all along retarded the progress of physiology. In this attempt men have left the province of philosophical research for that of fancy" (p. 182–183, § 350$\frac{3}{4}$ *gg*, p. 924–925, § 1085).—LIEBIG'S *Animal Chemistry.*

6. "In the processes of NUTRITION and REPRODUCTION, we perceive the passage of matter from the state of motion to that of rest (static equilibrium). Under the influence of the nervous system, this matter enters again into a state of motion. The ultimate causes of these different conditions of the vital force are CHEMICAL FORCES."

7. "THE CAUSE of the state of MOTION is to be found in a series of changes which the food undergoes in the organism, and these are the RESULTS OF PROCESSES OF DECOMPOSITION, to which either the food itself, or the STRUCTURES formed from it, or parts of organs, are subjected" (§ 1054).

8. "The change of matter, the manifestation of mechanical force, and the absorption of oxygen, are, in the animal body, so closely connected with each other, that we may consider the AMOUNT OF MOTION and the QUANTITY OF LIVING TISSUE TRANSFORMED, AS PROPORTIONAL TO THE QUANTITY OF OXYGEN inspired and consumed in a given time by the animal."—LIEBIG'S *Animal Chemistry* (no. 3, 4).

9. "If we employ these well-known facts as means to assist us in investigating the ultimate cause of the mechanical effects in the animal organism, observation teaches us that the MOTION OF THE BLOOD AND OF THE OTHER ANIMAL FLU-

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IMPARTING MOTION TO ATOMS AT REST, and of OPPOSING RESISTANCE TO OTHER forces producing motion, such as THE CHEMICAL FORCE, heat and ELECTRICITY."—LIEBIG'S *Lectures for* 1844.

"EVERY THING in the organism goes on *under the influence* of the VITAL FORCE, AN IMMATERIAL AGENT, which the chemist cannot employ at will."—LIEBIG'S *Animal Chemistry.*

54. "There is NOTHING to prevent us from considering the VITAL FORCE as a PECULIAR property, which is possessed by certain material bodies, and becomes sensible when their elementary particles are combined in a certain arrangement or form. This supposition takes from the *vital phenomena* nothing of their wonderful peculiarity. It may, therefore, be considered as a RESTING POINT from which an investigation into these phenomena, and the LAWS which regulate them, may be commenced; exactly as we consider the properties and laws of LIGHT to be dependent on a certain *luminiferous matter* or ether, which has no farther connection with the laws ascertained by investigation."—LIEBIG'S *Animal Chemistry.*

55. "EVERY THING in the animal organism, to which the name of MOTION can be applied, proceeds from the NERVOUS apparatus." "In animals we recognize in the *nervous apparatus* A SOURCE OF POWER CAPABLE OF RENEWING ITSELF at every moment of their existence." — LIEBIG'S *Animal Chemistry.*

56. "We may communicate MOTION to a body at rest by means of a *number of forces*, very different in their manifestations. Thus, a time-piece may be set in motion by a falling weight (*gravitation*), or by a bent spring (*elasticity*).

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IDS proceeds from distinct organs, which, as in the case of the HEART and intestines, DO NOT GENERATE THE MOVING POWER IN THEMSELVES, BUT RECEIVE IT FROM OTHER QUARTERS."—LIEBIG'S *Animal Chemistry* (no. 3, 4).

10. "Now, since the phenomena of MOTION in the animal body ARE DEPENDENT ON THE CHANGE OF MATTER, the increase of the change of matter in any part is followed by an increase of all the motions. Consequently, if, in consequence of a DISEASED TRANSFORMATION OF LIVING TISSUES, a greater amount of force be generated than is required for the production of the normal motions, it is seen IN THE ACCELERATION OF ALL OR SOME OF THE INVOLUNTARY MOTIONS, as well as in a HIGHER TEMPERATURE OF THE DISEASED PART."—LIEBIG'S *Animal Chemistry.* [*Such, with* § 350½, *i, and no.* 11, *is the chemical substitute for the medical aphorism,* "*ubi irritatio ibi affluxus.*" *It will be also seen from the foregoing nos.* 7, 8, 9, *that Liebig considers the circulation of the blood due to the agencies of oxygen, and not at all to the action of the heart.*]

11. "THE POWER to effect TRANSFORMATIONS *does not belong to the vital principle.* Each transformation is owing to a disturbance in the attraction of the elements of a compound, and is, consequently, A PURELY CHEMICAL PROCESS."—LIEBIG'S *Organic Chemistry applied to Physiology,* &c.

12. "The combinations of the CHEMIST relate to the change of matter, *forward and backward,* TO THE CONVERSION OF FOOD INTO THE VARIOUS TISSUES and secretions, and to their metamorphosis into *lifeless compounds;* HIS INVESTIGATIONS *ought to tell us* WHAT HAS

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Every kind of motion may be produced by the *electric* or *magnetic* force, as well as by *chemical attraction;* while we cannot say, as long as we only consider the manifestation of these forces in the phenomenon or result produced, which of these various causes of change of place has set the objects in motion. IN THE ANIMAL ORGANISM we are acquainted with ONLY ONE CAUSE OF MOTION, and this is the SAME CAUSE which *determines the growth* of living tissues and gives them *the power of resistance* to external agencies. IT IS THE VITAL FORCE."—LIEBIG, *ibid.*

57. "In order to attain *a clear conception* of these manifestations OF THE VITAL FORCE, SO DIFFERENT in form, we must bear in mind, that every known force is recognized by two conditions of activity," &c.—LIEBIG'S *Animal Chemistry.*

58. "Our notion of life involves something more than mere reproduction, namely, the idea of AN ACTIVE POWER exercised by virtue of a definite form, and production and generation in a definite form. The production of organs, and their power not only to produce their component parts from the food presented to them, but to GENERATE THEMSELVES *in their original form* and *with all their properties,* are characters BELONGING EXCLUSIVELY TO ORGANIC LIFE, and constitute a form of reproduction INDEPENDENT OF CHEMICAL POWERS. The chemical forces are sub-

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TAKEN PLACE AND WHAT CAN TAKE PLACE IN THE BODY."—LIEBIG'S *Animal Chemistry.*

13. "How beautifully and admirably SIMPLE, with the aid of these discoveries (*chemical*), appears the process of NUTRITION in animals, the FORMATION OF THEIR ORGANS," &c.

14. "In the hands of the physiologist, ORGANIC CHEMISTRY must become an intellectual instrument, by means of which he will be enabled to trace the CAUSES of phenomena INVISIBLE to the bodily sight."—LIEBIG'S *Animal Chemistry.*

14½. "Since, in different individuals, according to the amount of force consumed in producing voluntary mechanical effects, unequal quantities of living tissues are wasted, there must occur in every individual, unless the phenomena of motion are to cease entirely, a condition in which all voluntary motions are completely checked; in which, therefore, these occasion no waste. This condition is called sleep."—*Ibid.*

15. "The self-regulating STEAM-ENGINES furnish no unapt image of what occurs in the *animal body.*" "The body, in regard to the production of HEAT and FORCE, *acts just like one of these machines.*"—LIEBIG'S *Animal Chemistry.*

16. "THE VITAL FORCE UNITES in its manifestations ALL THE PECULIARITIES OF CHEMICAL FORCES, and of the not less wonderful CAUSE which we regard as the ultimate origin of ELECTRICAL phenomena."—LIEBIG'S *Animal Chemistry.*

17. "The mysterious VITAL

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ject TO THE INVISIBLE CAUSE BY WHICH THIS FORM IS PRODUCED. OF THE EXISTENCE OF THIS CAUSE ITSELF we are made aware ONLY *by the phenomena* which IT PRODUCES. ITS LAWS must be investigated *just* as we investigate THOSE of the OTHER POWERS which effect motion and changes in matter."—LIEBIG'S *Organic Chemistry applied to Physiology,* &c.

59. "It is not the true chemist who has endeavored to apply to the animal organism his notions derived from purely chemical processes. He has not had the remotest intention of undertaking the explanation of any really vital phenomenon upon chemical principles. The only part which chemistry now, or for the future, can take in the explanation of the vital processes, is limited to a more precise designation of the phenomena, and to the task of controlling the correctness of inferences, and insuring the accuracy of all observations by number and weight. Although the chemist is able to analyze organic bodies, and tell us their ultimate elements, he does not claim the power of synthesis, or of producing them again by the union of these elements"!!!—LIEBIG'S *Lectures for* 1844 (§ 350½–350⅔).—See no. 39.

60. "IN WHAT FORM OR IN WHAT MANNER THE VITAL FORCE PRODUCES MECHANICAL EFFECTS IN THE ANIMAL BODY IS ALTOGETHER UNKNOWN, AND IS AS LITTLE TO BE ASCERTAINED BY EXPERIMENT AS THE CONNECTION OF CHEMICAL ACTION WITH THE PHENOMENA OF MOTION, which we can produce with the galvanic battery. We know not how a *certain invisible something, heat,* gives to certain bodies the power of exerting an enormous pressure on surrounding objects. We know not even

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PRINCIPLE can be REPLACED by the CHEMICAL FORCES."—LIEBIG'S *Organic Chemistry applied to Physiology*, &c.

17½. "The animal body is a heated mass, which BEARS THE SAME RELATION TO SURROUNDING OBJECTS AS ANY OTHER HEATED MASS. It receives heat when the surrounding objects are hotter, it loses heat when they are colder than itself." — LIEBIG'S *Animal Chemistry*. (See § 350⅔, 440 *c*, 1044 *a*, *b*, 1046–1050.)

17¾. "The high temperature of the animal body is *uniformly and under all circumstances* the result of the combination of a combustible substance with oxygen."

"The CARBON of the food, which is converted into CARBONIC ACID within the body, must give out *exactly as much heat* as if it had been directly burned in the air, or in oxygen gas. The *only difference is*, that the amount of heat produced is diffused over unequal times."

"By the combination of oxygen with the constituents of the metamorphosed tissues, the TEMPERATURE NECESSARY TO THE MANIFESTATIONS OF VITALITY is produced in the carnivora."—LIEBIG'S *Animal Chemistry* (§ 440, nos. 17 and 18).

18. "The NERVES which accomplish the voluntary and involuntary MOTIONS in the body (no. 7–9) are, according to the preceding exposition, NOT THE PRODUCERS, but ONLY THE CONDUCTORS OF THE VITAL FORCE (§ 59). They permit

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HOW *this something* itself is produced when we burn wood or coals.

"So it is with THE VITAL FORCE and with THE PHENOMENA exhibited by living bodies. The CAUSE of these PHENOMENA IS NOT CHEMICAL force; IT IS NOT ELECTRICITY, nor magnetism. It is a PECULIAR FORCE, because it exhibits manifestations which are formed by NO OTHER KNOWN FORCE."

61. "In regard to the NATURE AND ESSENCE of the vital force, we can hardly deceive ourselves, when we reflect, that it behaves, in all its manifestations, exactly like OTHER natural forces; that it is devoid of consciousness or of volition, and is *subject to the action of a* BLISTER." — LIEBIG'S *Animal Chemistry*.

61½. "Certain other constituents of the blood may give rise to the formation of CARBONIC ACID IN THE LUNGS. But, all this has NO CONNECTION with that VITAL PROCESS BY WHICH THE HEAT necessary for the support of life IS GENERATED in every part of the body." —LIEBIG'S *Animal Chemistry*.

61¾. Nevertheless—"In the animal organism two processes of oxydation are going on; one in the lungs [the union of oxygen with an '*organic* compound of iron'], the other in the capillaries [the union of the absorbed oxygen with carbon, &c.]. By means of the FORMER, in spite of the degree of cooling, and of the increased evaporation which takes place there, the constant temperature of the LUNGS is kept up, while the heat of the REST OF THE BODY is supplied by the LATTER"!—LIEBIG'S *Animal Chemistry*.

62. "In the present state of our knowledge, *no one*, probably, WILL IMAGINE that ELECTRICITY is to be considered AS THE CAUSE of the phenomena of MOTION in the body." "*Every thing* in the animal organism to which the name

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the current to traverse them, and present, as CONDUCTORS OF ELECTRICITY, ALL THE PHENOMENA WHICH THEY EXHIBIT AS CONDUCTORS OF THE VITAL FORCE"!—LIEBIG'S *Animal Chemistry*. [Compare with no. 55.]

18½. "If CHEMICAL ACTION be excluded as a condition of *nervous agency*, it means nothing else than to derive the presence of MOTION, the MANIFESTATION OF FORCE, FROM NOTHING. BUT NO FORCE, NO POWER, CAN COME FROM NOTHING"!—LIEBIG'S *Animal Chemistry* (no. 5).

19. "By means of the NERVES, ALL PARTS of the body receive the moving force which is INDISPENSABLE to their functions, to change of place, to the production of mechanical effects. *Where nerves are not found, motion does not occur.* [In plants, for example?] The excess of force generated in one place is conducted to other parts by the nerves. The force which one organ cannot produce in itself is conveyed to it from other quarters, [!] and the vital force which is wanting to it, in order to furnish resistance to external causes of disturbance, it receives in the form of excess from another organ, an excess which that organ cannot consume in itself"!—LIEBIG'S *Animal Chemistry* (§ 422, 423, 733 *e*).

20. "The phenomena of MOTION IN VEGETABLES, the circulation of the sap, for example, observed in many of the characeæ, and the closing of flowers and leaves, depend on PHYSICAL and MECHANICAL causes. HEAT and LIGHT are the REMOTE CAUSES of MOTION in VEGETABLES; but in ANIMALS we recognize in the *nervous apparatus* A SOURCE OF POWER, capable of renewing itself at every moment of their existence."—LIEBIG'S *Animal Chemistry*.

21. "While the ASSIMILATION

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of MOTION can be applied *proceeds from the nervous* apparatus. In animals we recognize in the *nervous apparatus* A SOURCE OF POWER, CAPABLE OF RENEWING ITSELF at every moment of their existence."—LIEBIG'S *Animal Chemistry* (no. 55).

62½. "But all this (formation of carbonic acid) has *no connection* with that VITAL PROCESS *by which the heat* necessary for the support of life *is generated* in every part of the body."—LIEBIG'S *Animal Chemistry*.

63. "Pathology informs us that the true *vegetable life* is in NO WAY dependent on THIS APPARATUS (the cerebro-spinal); that the process of nutrition proceeds in those parts of the body where the NERVES of sensation and voluntary motion are paralyzed, exactly in the same way as in other parts where these nerves are in the normal condition; and, on the other hand, that the most energetic volition is incapable of exerting any influence on the contractions of the heart, on the motion of the intestines, or on the processes of secretion."—LIEBIG'S *Animal Chemistry*.

64. "Although plants require LIGHT, and, indeed, sun light, it is not necessary that the direct rays of the sun reach them. Their FUNCTIONS certainly proceed with greater intensity and rapidity in sunshine, than in the diffused light of day; but it merely ACCELERATES in a greater degree THE ACTION ALREADY EXISTING."—LIEBIG'S *Organic Chemistry applied to Physiology*, &c.

65. "THE VITAL PRINCIPLE is ONLY known to us through the peculiar form of ITS INSTRUMENTS.

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of food in VEGETABLES, and the WHOLE PROCESS OF THEIR FORMATION, are DEPENDENT on certain EXTERNAL INFLUENCES *which produce motion*, the *development* of the ANIMAL organism is, to a certain extent, *independent* of those external influences, just BECAUSE the ANIMAL body can produce WITHIN ITSELF THAT SOURCE OF MOTION WHICH IS INDISPENSABLE TO THE VITAL PROCESS."—LIEBIG'S *Animal Chemistry.*

22. "Neither the emission of carbonic acid nor the absorption of oxygen (by *plants*) has any connection with the process of ASSIMILATION; nor have they the slightest relation to each other. The one is *purely a mechanical*, the other a *purely chemical process.* A COTTON WICK, inclosed in a lamp, which contains a liquid saturated with carbonic acid, acts *exactly* in the same manner as a living plant in the night."—LIEBIG'S *Organic Chemistry applied to Physiology*, &c.

23. "At night, a true CHEMICAL process COMMENCES, in consequence of the action of the oxygen of the air upon the substances composing the leaves, blossoms, and fruit. This process is not at all connected with the life of the vegetable organism, because it goes on in the DEAD plant EXACTLY as in a *living* one"!

Nevertheless,

23½. "What value can be attached to experiments, in which all those matters which *a plant* REQUIRES in the process of ASSIMILATION, besides its MERE NUTRIMENT, have been EXCLUDED WITH THE GREATEST CARE? Can the LAWS OF LIFE be investigated in an organized being which is diseased or DYING?"—LIEBIG'S *Organic Chemistry applied*, &c.—Or, can those laws be investigated in

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that is, through the organs IN WHICH IT RESIDES. Hence, whatever kind of energy a substance may possess, if it is amorphous and destitute of ORGANS from which the IMPULSE, MOTION, or change, proceeds, IT DOES NOT LIVE. Its ENERGY depends, in THIS CASE, ON A CHEMICAL ACTION. LIGHT, HEAT, electricity, or other *influences* [justly considered *here* by Liebig as vital *stimuli* and *not forces*] may increase, diminish, or arrest THIS ACTION; but they ARE NOT ITS EFFICIENT CAUSE." "THE VITAL PRINCIPLE OPPOSES to the continual action of the atmosphere, moisture, and temperature, upon the organism, A RESISTANCE which is, in a certain degree, *invincible.* It is by the *constant neutralization* and *renewal* of these external influences that *life and motion are maintained.*" — LIEBIG'S *Organic Chemistry applied to Physiology*, &c. (§ 188½, *d*).

66. "An abnormal production of certain component parts of plants *presupposes* A POWER AND CAPABILITY OF ASSIMILATION, to which the most powerful CHEMICAL ACTION CANNOT BE COMPARED. The best idea of it may be formed, by considering that it surpasses in power the strongest galvanic battery, with which we are not able to separate the oxygen from carbonic acid, as is done by the *leaves of plants*," "and without the direct solar rays."

67. "All that we can do is to supply those substances which are adapted for ASSIMILATION BY THE POWER *already present* in the organs of the plant."—LIEBIG'S *Organic Chemistry applied to Physiology*, &c.

68. "The living part of a plant acquires the whole force and direction of its VITAL ENERGY from the absence of all conductors of force. BY *this means* the *leaf* is

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"*a cotton wick*, inclosed in a lamp?"

And so of animals.

24. "The permeability to gases is a mechanical property, *common to* ALL ANIMAL tissues; and is found in the SAME DEGREE in the LIVING as in the DEAD tissue"!—LIEBIG'S *Animal Chemistry* (§ 350½, *n*, and *Medical and Physiological Commentaries*, vol. i., p. 565, 569, *notes*, 683–690).

24½. "The surface of the body is the membrane from which evaporation goes constantly forward. IN CONSEQUENCE OF THIS EVAPORATION ALL THE FLUIDS OF THE BODY, IN OBEDIENCE TO ATMOSPHERIC PRESSURE, EXPERIENCE MOTION in the direction toward the evaporating surface. This is obviously the CHIEF CAUSE of the passage of the nutritious fluids through the walls of the blood-vessels [*strained off*], and THE CAUSE OF THEIR DISTRIBUTION THROUGH THE BODY. We know NOW what important function the skin fulfills through evaporation"! —LIEBIG'S *Researches on the Chemistry of Food*, &c., *American Journal of Science and Arts*, May, 1848, p. 415.—See *contradiction* in nos. 5, 6, 7, 8, 9, 10, 69–75. Also § 350½ *n*.

25. "Analogy, that fertile source of error, has unfortunately led to the very UNAPT COMPARISON of the VITAL functions of PLANTS with those of ANIMALS."—LIEBIG'S *Organic Chemistry applied to Physiology*, &c.

26. "ALL SUBSTANCES IN SOLUTION IN A SOIL ARE ABSORBED BY THE ROOTS OF PLANTS, EXACTLY AS A SPONGE IMBIBES A LIQUID, AND ALL THAT IT CONTAINS, WITHOUT SELECTION," and "THEIR ASSIMILATION is a PURELY CHEMICAL PROCESS."—IBID. (no. 22, § 289–291).

Nevertheless,

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enabled to overcome the *strongest chemical attractions*, to DECOMPOSE CARBONIC ACID, and to ASSIMILATE the ELEMENTS of its nourishment."—LIEBIG'S *Animal Chemistry*.

69. "In vegetable physiology, a leaf is regarded in every case *merely as a leaf*, notwithstanding that leaves generating oil of turpentine or oil of lemons, *must possess a different nature* from those in which oxalic acid is formed. VITALITY, in its *peculiar operations*, MAKES USE of a SPECIAL apparatus for *each* function of an organ. Vegetable physiologists, in the study of their science, have not directed their attention to *that part* of it (the laws of vitality) which is *most worthy* of investigation."—LIEBIG'S *Organic Chemistry applied to Physiology*, &c.

70. "In the living plant, the INTENSITY of the VITAL FORCE far exceeds that of the CHEMICAL ACTION of oxygen. We know, with the UTMOST CERTAINTY, that, by the influence of the VITAL FORCE, OXYGEN is separated FROM ELEMENTS to which it has the strongest affinity; and that it is given out in the gaseous form, without exerting the slightest action on the juices of the plant."—LIEBIG'S *Animal Chemistry*.

71. "THE ANIMAL ORGANISM IS A HIGHER KIND OF VEGETABLE."

"ASSIMILATION, or the process of FORMATION and GROWTH, goes on in the SAME WAY in ANIMALS and in VEGETABLES. In both the SAME CAUSE determines the increase of mass. This constitutes the TRUE vegetative life."—LIEBIG'S *Animal Chemistry*.

72. "The CONSTITUENTS of VEGETABLE and animal substances *are formed* under the guidance and power of THE VITAL PRINCIPLE, which *determines* the direction of their molecular *attraction*" "IN

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26½. "When roots FIND their MORE APPROPRIATE BASE in sufficient quantity, they will take up LESS OF ANOTHER."—*And, again* (*in opposition to the simile of the "sponge," and "lamp-wick"*): "It is thought very remarkable, that those PLANTS of the grass tribe, the seeds of which furnish food for man, *follow him like the domestic animals.* But *saline* plants *seek the sea-shore* or *saline springs*, and the *Chænopodium the dung-hill* from similar causes. Saline plants require common salt, and plants which grow on dung-hills, only, need ammonia and nitrates, and they are attracted whither these can be found, *just as* the dung-fly is to animal excrements." "The roots of plants are constantly engaged in *collecting* from the rain those *alkalies* which formed part of the sea-water, and also those of the water of springs which penetrates the soil."

27. "Each new *radical fibril* which a plant acquires may be regarded as constituting, at the same time, A MOUTH, A LUNG, and A STOMACH. The *roots* perform the functions of the *leaves* from the first moment of their formation; they EXTRACT from the soil their proper nutriment, namely, the CARBONIC ACID generated by the humus."—LIEBIG'S *Organic Chemistry applied to Physiology.*

28. ["*Nature speaks to us in a peculiar language, in the language of phenomena. She answers, at all times, the questions which are put to her; and such questions are experiments. An experiment is the expression of a thought. We are nearer the truth,* WHEN THE PHENOMENON, *elicited by the* EXPERIMENT, CORRESPONDS TO THE THOUGHT; *while* THE OPPOSITE *result shows that the question was* FALSELY STATED, *and that the conception was*

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the formation of *vegetable* and animal substances, THE VITAL PRINCIPLE opposes, as a FORCE OF RESISTANCE, the action of the OTHER FORCES," &c.—LIEBIG'S *Lectures for* 1844.—See p. 31, § 59.

73. "THE FORCE which gives to the germ, the leaf, and the RADICAL FIBRES of the VEGETABLE THE SAME WONDERFUL PROPERTIES (digestion, circulation, and secretion), IS THE SAME AS THAT residing in the secreting membranes and glands of ANIMALS, and which enables every animal organ to perform its own proper functions."—LIEBIG'S *Animal Chemistry.*

74. "In the ANIMAL organism the VITAL FORCE EXHIBITS ITSELF AS IN THE PLANT, in the form of GROWTH, and AS THE MEANS OF RESISTANCE TO EXTERNAL AGENCIES."—IBID.

75. "If we assume that ALL THE PHENOMENA exhibited by the organism of PLANTS and animals are to be ascribed to A PECULIAR CAUSE, different in its manifestations from ALL OTHER CAUSES which produce MOTION OR CHANGE OF CONDITION; if, therefore, we regard THE VITAL FORCE as an INDEPENDENT FORCE (no. 3), then, in the phenomena of organic life, as in all other phenomena ascribed to the action of forces, we have the *statics*, that is, the state of equilibrium determined by a RESISTANCE, and the DYNAMICS OF THE VITAL FORCE"!—IBID.

76. "Vegetables produce in their organism THE BLOOD OF ALL ANIMALS."—LIEBIG, *ibid.*

To occupy space, nos. 26½ and 27 are contrasted with nos. 25 and 26 in the same column. And so with 5½, 23½. But here is more in the more appropriate place, upon this fundamental point. Thus:

77. "When it is considered that sea-water contains less than

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ERRONEOUS."—LIEBIG'S *Organic Chemistry*, &c. (§ 1052, 1054).

[I pause in my quotations for the purpose of indicating the important bearing of the "*chemistry of plants*" upon the chemical philosophy of digestion in animals as carried on by the gastric juice. Now, if in the latter case the agencies be of a chemical nature, there should be some analogy between the supposed chemical transformation of organic compounds by the gastric juice and the transformation of inorganic substances into organic compounds as effected by plants, especially considering that "vegetables produce in their organism *the blood of all animals*" (no. 76). Chemistry is prodigal of experiments, and of supposititious agents from pepsin to chlorine, in resolving digestion by animals, but vouchsafes scarcely a word in behalf of that "*creative* function" by which "the blood of all animals" is generated by plants out of the elements of matter. Will Chemistry explain (§ 301, 360)?]

29. "The most decisive experiments of physiologists have shown that the process of CHYMIFICATION *is independent of the* vital force; that it takes place in virtue of a PURELY CHEMICAL action, EXACTLY SIMILAR to those processes of DECOMPOSITION or transformation which are known as PUTREFACTION, FERMENTATION, or DECAY."—LIEBIG'S *Animal Chemistry*.

"Those remarkable phenomena, FERMENTATION, PUTREFACTION, and DECAY, are THE PROCESSES of DECOMPOSITION, and their ultimate results are to RECONVERT the elements of organic bodies into that state in which they exist before they participate in the processes of life."—LIEBIG'S *Lectures for* 1844.

30. "The second part of the work will treat of the CHEMICAL processes which effect the COMPLETE DESTRUCTION of plants and animals AFTER DEATH, such as the *peculiar* modes of decomposition usually described as *fermentation*, *putrefaction*, and *decay*."—LIE-

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$\frac{1}{1000000}$ of its own weight of iodine, and that all combinations of iodine with the metallic bases of alkalies are highly soluble in water, *some provision must necessarily be supposed to exist* IN THE ORGANIZATION of sea-weed and the different kinds of force by which they are enabled, DURING THEIR LIFE, TO EXTRACT IODINE in the form of a soluble salt from sea-water, and TO ASSIMILATE IT IN SUCH A MANNER that it is not again restored to the surrounding medium. These plants are COLLECTORS OF IODINE, JUST AS LAND PLANTS ARE OF ALKALIES; and they yield us this element IN QUANTITIES such as we could not otherwise obtain from the water without the evaporation of WHOLE SEAS."—LIEBIG'S *Organic Chemistry applied to Physiology*, &c.—(§ 1054).

78. "The EQUILIBRIUM in the chemical attractions of the constituents of food is disturbed BY THE VITAL PRINCIPLE;" and "THE UNION OF its ELEMENTS, so as to produce *new combinations* and *forms* indicates *a peculiar mode of attraction*, and the existence of A POWER DISTINCT FROM ALL OTHER POWERS OF NATURE, namely, the VITAL PRINCIPLE."—LIEBIG'S *Organic Chemistry applied to Physiology*, &c.

79. "The VITAL FORCE CAUSES A DECOMPOSITION of the constituents of food, and destroys the force of attraction which is continually exerted between their molecules. It alters the direction of the CHEMICAL FORCES in such wise, that the ELEMENTS of the constituents of the food arrange themselves in another form, and combine to produce *new compounds*. It FORCES the *new compounds* to assume forms ALTOGETHER DIFFERENT from those which are the result of the attraction of cohesion when acting free-

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BIG'S *Organic Chemistry applied to Physiology*, &c.

31. "In the SAME WAY as MUSCULAR FIBRE, when separated from the body, communicates the state of decomposition existing in its elements to the peroxide of hydrogen, so a certain product, arising by means of the vital process, and *by consequence of the transposition of the elements of parts of the stomach and of the other digestive organs* [!] while its own metamorphosis is accomplished in the stomach, ACTS ON THE FOOD. The insoluble matters are DIGESTED"!—LIEBIG'S *Animal Chemistry*.

32. "Is it truly VITALITY, which generates SUGAR IN THE GERM for the nutrition of young plants, or which gives to the STOMACH the power to dissolve and to prepare for assimilation all the matter introduced into it? A DECOCTION OF MALT possesses as little power to reproduce itself, as the *stomach* of a DEAD CALF. Both are, unquestionably, destitute of life. But, when starch is introduced into a decoction of malt, it changes, first into a gummy matter, and lastly into sugar. Hard-boiled albumen, and muscular fibre, can be dissolved in a decoction of a calf's stomach, to which a few drops of muriatic acid have been added, PRECISELY *as in the stomach itself*."—LIEBIG'S *Organic Chemistry*, &c. (no. 11).

33. "*All substances* which can arrest the phenomena of *fermentation* and *putrefaction* in liquids, also *arrest digestion* when taken into the stomach"!—LIEBIG'S *Animal Chemistry*.

34. "In the natural state of the digestive process, the food *only undergoes a change in its state of cohesion*, becoming fluid without any other change of properties."—LIEBIG'S *Animal Chemistry*.

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ly, that is, without resistance."—LIEBIG'S *Animal Chemistry*.

80. "It is well known that in many graminivorous animals, where the digestive organs have been overloaded with fresh juicy vegetables, these substances UNDERGO IN THE STOMACH THE SAME DECOMPOSITION as they would at the same temperature OUT OF THE BODY. They pass into FERMENTATION and PUTREFACTION, whereby so great a quantity of CARBONIC ACID GAS and of INFLAMMABLE GAS IS GENERATED, that these organs are enormously distended, and sometimes even to BURSTING."—LIEBIG'S *Animal Chemistry*.

81. "The VITAL FORCE appears as a MOVING FORCE or cause of motion, when it OVERCOMES the CHEMICAL FORCES, cohesion and AFFINITY, which act between the constituents of food, and when IT CHANGES the position or place in which their ELEMENTS occur. The VITAL FORCE is manifested as A CAUSE OF MOTION in OVERCOMING THE CHEMICAL ATTRACTION of the constituents of food, and is, farther, THE CAUSE WHICH COMPELS them to combine in a new arrangement, and to assume new forms.'—LIEBIG'S *Animal Chemistry*.

82. "It will be shown in the second part of this work, that all plants and vegetable structures undergo two processes of decomposition AFTER DEATH. One of these is named FERMENTATION, the other DECAY OR PUTREFACTION."—LIEBIG'S *Organic Chemistry applied to Physiology*, &c., (§ 349, *c*, *e*).

83. "The individual organs such as the STOMACH, cause all the organic substances conveyed to them, which are capable of transformation, to assume NEW FORMS. The STOMACH *compels* the ELE-

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35. Although "the process of CHYMIFICATION IS INDEPENDENT of the *vital force*, and takes place in virtue of a *purely chemical action*, EXACTLY *similar* to those processes of decomposition which are known as PUTREFACTION, FERMENTATION, or DECAY;" nevertheless, "INORGANIC compounds DIFFER from ORGANIC *in as great a degree* as in their SIMPLICITY *of constitution*."—LIEBIG'S *Animal Chemistry*, and *Organic Chemistry*.

36. "THE POWER of elements to unite together, and to form peculiar compounds which are generated in animals and vegetables, is CHEMICAL AFFINITY."—LIEBIG'S *Organic Chemistry applied to Physiology*, &c.

37. "We should not permit ourselves to be withheld, by the idea of a VITAL PRINCIPLE, from considering in a CHEMICAL POINT OF VIEW, the process of TRANSFORMATION OF THE FOOD, and its ASSIMILATION by the VARIOUS ORGANS. This is the more necessary, as the views hitherto held have produced no results, and are quite incapable of useful application."—LIEBIG'S *Organic Chemistry applied*, &c.

38. "We know that an organized body cannot generate substances, but only change the mode of their combinations, and that its SUSTENANCE and REPRODUCTION *depend* upon the CHEMICAL transformation of the matters which are employed as its nutriment, and which contain its own constituent

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MENTS of these substances to unite into a COMPOUND *fitted* for the formation of the blood."—LIEBIG'S *Organic Chemistry*, &c.

84. "The FIRST substance capable of affording nutriment to animals is the LAST product of the CREATIVE ENERGY of vegetables."—LIEBIG'S *Animal Chemistry*.

85. "The special characters of food, that is, of substances fitted for assimilation, are ABSENCE OF ACTIVE CHEMICAL PROPERTIES, and the capability of yielding to transformations."—LIEBIG'S *Organic Chemistry applied to Physiology* &c.

86. "*All experience proves* that there is in the organism only *one* source of *physical* power; and this source is the *conversion of living parts into lifeless*, AMORPHOUS COMPOUNDS."—LIEBIG'S *Animal Chemistry*.

86½. "It is only with the COMMENCEMENT of *chemical* action that the separation of a part of an organ in the form of *lifeless* compounds *begins*."—LIEBIG'S *Animal Chemistry*.

87. "When a chemical compound of simple constitution is introduced into the stomach, its CHEMICAL ACTION is, of course, OPPOSED BY THE VITAL PRINCIPLE The results produced depend upon the strength of their respective actions. Either an *equilibrium* of BOTH POWERS is attained, a change being effected without the *destruction of the vital principle;* in which case a MEDICINAL EFFECT is occasioned. Or, the acting body YIELDS TO THE SUPERIOR FORCE OF VITALITY, that is, IT IS DIGESTED. Or lastly, the CHEMICAL ACTION obtains the ascendency and ACTS AS A POISON."—LIEBIG'S *Organic Chemistry applied to Physiology* &c.

87½. "The VITAL POWER in veg

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elements. Whatever we regard as the cause of these transformations, the act of transformation is a PURELY CHEMICAL PROCESS. It will be shown, when considering the processes of *fermentation* and *putrefaction*, that any disturbance of the mutual attraction subsisting between the elements of a body gives rise to a transformation."—LIEBIG'S *Organic Chemistry*, &c.

39. "By CHEMICAL AGENCY we can produce the CONSTITUENTS of muscular fibre, skin, and hair"! "We are able to form, in our laboratories, formic acid and urea, &c., all products, IT IS SAID, of the VITAL PRINCIPLE. We see, therefore, that this MYSTERIOUS VITAL PRINCIPLE CAN BE REPLACED BY THE CHEMICAL FORCES"!!—LIEBIG'S *Organic Chemistry* (no. 16, 51, 59, § 53).

40. "The INFLUENCE of poisons and of remedial agents on the living animal body evidently shows that the CHEMICAL decompositions and combinations in the body, WHICH MANIFEST THEMSELVES IN THE PHENOMENA OF VITALITY, may be increased in intensity by CHEMICAL FORCES of an analogous character, and retarded or PUT AN END TO by THOSE of opposite character:

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etables accomplishes the TRANSFORMATION OF MINERAL substances into an organism endowed with life." — LIEBIG'S *Animal Chemistry*.

87¾. "The cause of *waste* of matter is the chemical action of oxygen. This waste of matter occurs in consequence of the absorption of oxygen into the substances of living parts. This absorption of oxygen *occurs only* when the resistance which the *vital force of living parts* opposes to the chemical action of the oxygen is weaker than that chemical action."—LIEBIG'S *Animal Chemistry* (nos. 3, 4, 7, 8, 11, 86½).

88. "The CONSTITUENTS of VEGETABLE and ANIMAL substances HAVING BEEN FORMED *under* THE GUIDANCE AND POWER of the VITAL PRINCIPLE, *it is this principle* which *determines* the direction of their molecular attraction." "*The vital principle* ALONE is capable of restoring the original order and manner of the molecular arrangement in the smallest particles of albumen."—LIEBIG'S *Lectures for* 1844 (§ 48–50).

"We cannot expect from organic chemistry the SYNTHETIC proof of the accuracy of the views entertained, because EVERY THING in the organism goes on UNDER THE INFLUENCE of the VITAL FORCE, AN IMMATERIAL AGENT [!] which the chemist CANNOT EMPLOY at will."—LIEBIG'S *Animal Chemistry*.

89. "From the theory of disease developed in the preceding pages, it follows, obviously, that a *diseased* condition once established, in any part of the body, CANNOT be made to disappear by the CHEMICAL ACTION of a remedy."—LIEBIG'S *Animal Chemistry*.

90. "THE VITAL FORCE IS SUBJECT TO THE ACTION OF A BLISTER."—*Ibid.*

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and that we are enabled to exercise an influence on every part of an organ by means of substances possessing a well-defined CHEMICAL ACTION."—LIEBIG'S *Animal Chemistry* (mottoes *a–e*).

41. "It is singular that we find medicinal agencies ALL DEPENDENT ON CERTAIN MATTERS, which differ in composition [*moral emotions, heat, cold, change of air, exercise?*]; and if, by the introduction of a substance, certain abnormal conditions are rendered normal, *it will be impossible* to reject the opinion, that this phenomenon depends on a CHANGE IN THE COMPOSITION of the constituents of the diseased organism [no. 5], a change in which the ELEMENTS OF THE REMEDY TAKE A SHARE SIMILAR TO THAT WHICH THE VEGETABLE ELEMENTS OF FOOD have taken in the formation of *fat, of membranes, of the saliva, of the seminal fluid*, &c. [!] Their carbon, hydrogen, or nitrogen, or whatever else belongs to their composition, are derived from the vegetable organism; and, after all, *the action and effects* of quinine, morphia, and the vegetable poisons in general, *are no hypotheses*" ! — LIEBIG'S *Animal Chemistry* (§ 18, and motto *d*).

42. "With respect to the ACTION of quinine, or the alkaloids of opium, &c., physiologists and pathologists entertain no doubt that it is exerted chiefly on the brain and nerves. If we reflect that this action is exerted by substances which are material, tangible, and ponderable; that they disappear in the organism; that a double dose acts more powerfully than a single one; that, after a time, a fresh dose must be given if we wish to produce the action a second time; all *these considerations*, viewed *chemically*, [!] permit only one form of explanation; the supposition,

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91. "The VITAL FORCE in a living animal tissue appears as A CAUSE of growth in the mass, and of RESISTANCE to those external agencies which tend TO ALTER the form, structure, and COMPOSITION of the SUBSTANCE of the tissue in which the *vital energy resides*."—LIEBIG'S *Animal Chemistry*.

92. "The *slightest action* of a *chemical* agent upon the blood exercises an INJURIOUS INFLUENCE. Even the momentary contact with the air in the lungs, although effected through the medium of cells and membranes, alters the color and other qualities of the blood."—LIEBIG'S *Organic Chemistry applied to Physiology*, &c.

93. "Every substance may be considered as NUTRIMENT, which loses its former properties when acted on by the VITAL PRINCIPLE, and does not exercise a *chemical* action upon the living organ. ANOTHER CLASS of bodies change the direction, the strength, and intensity of the *resisting vital principle* and THUS exert a modifying influence upon the FUNCTIONS of its organs. *These* are MEDICAMENTS. A THIRD CLASS of compounds are called POISONS, WHEN they possess the property of UNITING WITH ORGANS or with their component parts, and *when their power of effecting this is stronger than the resistance offered by the vital principle*."—LIEBIG'S *Organic Chemistry*, &c.

93½. "Death is the condition in which all resistance on the part of the vital force entirely ceases. So long as this condition is not established the living tissues continue to offer resistance."—LIEBIG'S *Animal Chemistry*.

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namely, that these compounds, by means of their elements, take a share *in the* FORMATION *of new* OR THE TRANSFORMATION OF EXISTING BRAIN AND NERVOUS MATTER"!!—LIEBIG'S *Animal Chemistry.*

43. "Owing to its volatility and the ease with which its vapor permeates animal tissues, ALCOHOL CAN SPREAD THROUGHOUT THE BODY IN ALL DIRECTIONS"!—LIEBIG'S *Animal Chemistry* (§ 350½, *n*).—NOTES N R pp. 1121, 1123.

44. "It is impossible to mistake the *modus operandi* of putrefied sausages, or muscle, urine, cheese, cerebral substance, and other matters, in a state of *putrefaction.*" "It is obvious that they COMMUNICATE THEIR OWN STATE OF PUTREFACTION TO THE SOUND BLOOD, from which they were produced, *exactly in the same manner as gluten* in a state of decay or putrefaction *causes a similar transformation in a solution of sugar*"!

45. "The MODE OF ACTION of a *morbid virus* exhibits such a STRONG SIMILARITY TO THE ACTION OF YEAST upon liquids containing sugar and gluten, that the two processes have been long since *compared* to one another, although merely for the purpose of *illustration.* [They have often been represented as *identical.*] But, when the phenomena attending the action of each respectively are considered more closely, it will in REALITY be seen that their influence DEPENDS UPON THE SAME CAUSE." "*Ordinary yeast*, and the *virus of human small-pox*, effect a violent tumultuous transformation, the former in vegetable juices, the latter *in the blood*"! "The action of the *virus of cow-pox* is analogous to that of *low yeast* [!] It communicates *its own state of decomposition* TO A MATTER in the blood, and from a SECOND MATTER is itself re-

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[*The next following* (94) *is confirmed by other observations, showing that* ALCOHOL, *Opium, and Tobacco are not absorbed, but act through the nervous system*, p. 301–310, § 481–484. Alcohol is digested.]

94. "According to *all the observations* hitherto made, *neither* the expired air, nor the perspiration, nor the urine, *contains* ANY TRACE OF ALCOHOL, after indulgence in spirituous liquors."—LIEBIG'S *Animal Chemistry.**

95. "The VIVIFYING agency of the BLOOD must ever continue to be the most important condition in the *restoration* of a disturbed EQUILIBRIUM, and the blood must, therefore, be considered and constantly kept in view, as the ultimate and MOST POWERFUL CAUSE OF LASTING VITAL RESISTANCE, as well in the DISEASRD as in the UNAFFECTED parts of the body."—LIEBIG'S *Animal Chemistry.*

Nevertheless,

"No other component part of the organism *can be compared* to the BLOOD, in respect of the FEEBLE RESISTANCE which it offers to exterior influences." "The chemical force and the vital principle hold each other in such perfect EQUILIBRIUM, that every disturbance, *however trifling*, or from WHATEVER CAUSE it may proceed, EFFECTS A CHANGE IN THE BLOOD."—LIEBIG'S *Organic Chemistry applied*, &c.

But, again, nevertheless,

"It is obvious, moreover, that in all diseases where the formation of contagious matter and of exanthemata is accompanied by fever, TWO diseased conditions *simultaneously* exist, and two processes are simultaneously completed; and that the BLOOD, as it were, BY REACTION, that is, fever, BECOMES A MEANS OF CURE."—LIEBIG'S *Animal Chemistry.*

* This is contradicted by French chemists, who deny, also, that alcohol is "burned," but assert that it exists in the body in a free state.—1861.

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generated"! "The *susceptibility* of infection by the virus of human small-pox MUST CEASE *after vaccination*, FOR THE SUBSTANCE to the presence of which this susceptibility is owing HAS BEEN REMOVED from the body by a peculiar process of DECOMPOSITION artificially excited"! "COLD MEAT is always in a state of decomposition. It is possible that THIS STATE may be communicated TO THE SYSTEM of a FEEBLE individual, and may be one of the SOURCES OF CONSUMPTION"!! (§ 821)—LIEBIG'S *Organic Chemistry applied to Physiology*, &c.

"*From the unequal degree of the conducting power* in the nerves, we must deduce those conditions which are termed paralysis, syncope, and spasm"!—LIEBIG'S *Animal Chemistry*.

46. "IN ALL CHRONIC DISEASES, DEATH IS PRODUCED BY THE SAME CAUSE, NAMELY, THE CHEMICAL ACTION OF THE ATMOSPHERE."

"THE TRUE CAUSE OF DEATH IS THE RESPIRATORY PROCESS, [!] that is, the chemical action of the atmosphere." — LIEBIG'S *Animal Chemistry* (§ 674–676).

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96. "It is only by a just application of its principle that any theory can produce really beneficial results."—LIEBIG'S *Animal Chemistry*.

97. "We can have no very high idea of experiments made by gentlemen (*chemists*, with reference to digestion) who, for want of anatomical knowledge, have not been able to pursue their reasoning even beyond the simple experiment itself." — JOHN HUNTER'S *Observations on Digestion*.

98. "Whenever the chemist forsakes his laboratory for the bedside, he forfeits all his claims to our respect, and his title to our confidence. It is amusing to see the ridiculous errors into which the chemist falls when he turns physician."—PARIS' *Pharmacologia*. London, 6th ed., 1825.

*** The quotations from "Liebig's Organic Chemistry applied to Physiology" are derived from Mr. Playfair's edition, London, 1840; those from "Liebig's Animal Chemistry" are taken from Professor Gregory's edition, reprinted New York, 1842. The italics and capitals are mine.

350¼. To carry out the full object of the foregoing section, I shall devote another to a farther exhibition of the pathological and therapeutical doctrines which have been deduced by the author of the "new era in medicine" from his chemical and physiological elements, as their resulting compounds. This more extended display of theoretical and practical doctrines, as they came to us from the laboratory, will reflect a broad light upon the chemical hypotheses of digestion, nutrition, &c., as set forth in the preceding section, and show us, also, the extent of the probabilities which relate to the analysis of food and of the conclusions which are predicated of that analysis (§ 18, 409, 676 *b*), and, in brief, enable us to comprehend the nature and amount of the service which organic chemistry has rendered to the science of medicine (§ 5, 5½ *a*, 376½, 1029, 1030, 1034).

This otherwise isolated subject will be farther interesting, as I shall embrace in the quotations the whole science of medicine as founded

on chemistry and physics, and thus place in contrast the systems of the two rival schools, and enable the reader to adjust their relative merits. To do this work of consigning chemistry to its legitimate pursuits the more effectually, I shall also expose, in an appropriate place, the chemical doctrine of animal heat in the language of him who is supposed to have settled the philosophy of that subject (§ 433–450, 676, 1043–1050).

And before proceeding to a farther exposition of the vital and chemical doctrines of digestion, I shall, in consideration of the general surrender of this subject to the laboratory of the chemist, exhibit the corroborating testimony of the distinguished Mülder that physiology and medicine have nothing to hope from observations conducted out of the living body (§ 350, nos. 48,49, also LEHMANN, §1029, 1030).

By the method now contemplated obstacles may be removed, and the reader better disposed to consider maturely the grounds upon which I have placed the vital doctrine of digestion, and come the more willingly to the conclusion that none are so imperfectly qualified to interpret the properties and laws of organic beings as they who can reason alone from the slender and deceptive analogies supplied by inorganic nature, and artificial expedients.

It is certainly remarkable that this systematic exposure should be necessary at the middle of the nineteenth century, when arts and all other sciences, though more so the arts, are making a steady, sometimes an astonishing progress.

I may be mistaken in the importance which I have attributed to the innovations which have been made by organic chemistry upon medical philosophy. I know that I am but feebly sustained by others in my conclusions; though now and then a blaze of mind assures me that deep volcanic action is in smothered progress (§ 376¾).

350½, *a*. We have, then, from the authorized works of Liebig (§ 349, *d*), in the first place, the following inductions, in the order of their occurrence, of

Pathological Principles, or "Theory of Disease" (350, no. 59).

"Every substance or matter, every chemical or mechanical agency, which changes or disturbs the restoration of the equilibrium between the manifestations of the causes of waste and supply, in such a way as to add its action to the causes of waste, is called a cause of disease. Disease occurs when the sum of the *vital force*, which tends to neutralize all *causes of disturbance*, in other words, when the resistance offered by the vital force, is weaker than *the acting cause of disturbance;*"—with the reservation, nevertheless, that "*the cause of disturbance, or chemical force and the vital force, are one and identical.*"

350½, *b*. "Death is the condition in which all resistance on the part of the vital force entirely ceases. So long as this condition is not established, the living tissues continue to offer resistance."

350½, *c*. "To the observer, the action of a cause of disease exhibits itself in the disturbance of the proportion between waste and supply which is proper to each period of life. In medicine, every abnormal condition of supply or of waste, in all parts, or in a single part of the body, is called *disease.*"

350½, *d*. "It is evident that one and the same cause of disease will produce in the organism very different effects, according to the period

of life. A cause of disease which strengthens the causes of supply, either directly or indirectly, by weakening the action of the causes of waste, destroys, in the child and in the adult, the relative normal state of health; while in old age it merely brings the waste and supply into equilibrium.

350½, *e.* "A child, *lightly clothed*, can bear cooling by a low external temperature without injury to health. [!] The force available for mechanical purposes and the temperature of its body increase with the change of matter which follows the cooling; while a high temperature, which impedes the change of matter, is followed by disease."

350½, *f.* "A deficiency of resistance, in a living part, to the causes of waste, is, obviously, a deficiency of resistance to the action of the oxygen of the atmosphere.

350½, *g.* "When, from any cause whatever, this resistance diminishes in a living part, the change of matter increases in an equal degree.

350½, *h.* "Now, since the phenomena of motion in the animal body are dependent on the change of matter, the increase of the change of matter in any part is followed by an increase of all motions. According to the conducting power of the nerves, the available force is carried away by the nerves of involuntary motion alone, or by all the nerves together. [!]

350½, *i.* "Consequently, if, in consequence of a diseased transformation of living tissues, a greater amount of force be generated than is required for the production of the normal motions, it is seen in an acceleration of all or some of the involuntary motions, as well as in a higher temperature of the diseased part. This condition is called *fever*.

350½, *j.* "When a great excess of force is produced by change of matter, the force, since it can only be consumed by motion, extends itself to the apparatus of *voluntary motion*. This state is called *a febrile paroxysm*.

350½, *k.* "In consequence of the acceleration of the circulation in the state of fever, a greater amount of arterial blood, and, consequently, of oxygen, is conveyed to the diseased part, as well as to all other parts; and, if the active force in the healthy parts continue uniform, the whole action of the excess of oxygen must be exerted on the diseased part alone (§ 350, no. 10).

350½, *l.* "According as a single organ, or a system of organs, is affected, *the change of matter* extends to one part alone, or to the whole affected system.

350½, *m.* "Should there be formed, in the diseased parts, in consequence of *the change of matter*, from the elements of the blood or of the tissue, NEW PRODUCTS, which the neighboring parts cannot employ for their own vital functions; should the surrounding parts, moreover, be unable to convey these products to other parts, where they may undergo transformation, then *these new products* will suffer, at the place where they have been formed, *a process of decomposition analogous to fermentation or putrefaction*" !

350½, *n.* "If we consider the fatal accidents which so frequently occur in wine countries from the drinking of what is called feather white wine, we can no longer doubt that GASES OF EVERY KIND, *whether soluble or insoluble in water, possess the property of permeating ani-*

mal tissues, as water penetrates unsized paper [!] (§ 350, no. 24). This poisonous wine is wine still in a state of fermentation, which is increased by the heat of the stomach. The carbonic acid which is disengaged penetrates through the parietes of the stomach, [!!] through the diaphragm, [!!!] and through all the intervening membranes, [!!!!] into the air-cells of the lungs, [!!!!!] out of which it displaces the atmospherical air. [!!!!!!] The patient dies with all the symptoms of asphyxia caused by an irrespirable gas, [!] and the surest proof of the presence of carbonic acid in the lungs is the fact, that the inhalation of ammonia, which combines with it, is recognized as the best antidote against this kind of poisoning"!—(§ 1055).

"No doubt a part of these gases may ENTER THE VENOUS CIRCULATION through the absorbent and lymphatic vessels, and thus reach the lungs, where they are exhaled; [!] but the presence of membranes offers not the SLIGHTEST OBSTACLE to their passing directly into the cavity of the chest"! (§ 349 *d*, 447 *b*, 827 *h*).

350½, *o*. "It is known that in cases of *wounds of the lungs* a peculiar condition is produced, in which, by the act of inspiration, not only oxygen but atmospherical air, with its whole amount of nitrogen, penetrates into the cells of the lungs. This air is carried by the circulation [!] to every part of the body, [!!] so that EVERY PART is inflated or puffed up with the air, as with water in dropsy. [!] This state ceases, without pain, as soon as the entrance of the air through the wound is stopped."

350½, *p*. "The frightful effects of prussic acid, which, when inspired, puts a stop to all the phenomena of motion in a few seconds, are explained in a natural manner by the well-known action of this compound on those of iron, when alkalies are present"!! (§ 494 *dd*, 827 *d*, 904 *b*).—LIEBIG'S *Animal Chemistry*.

350½, *q*. The foregoing doctrines, with the humoral philosophy as quoted in § 350, nos. 40–45, make up the whole science of pathology as delivered to us from the laboratory; and such, too, are the doctrines which are hailed as the foundation of "a new and the greatest era of medicine." There can be no doubt, however, that deliberate investigation will satisfy every mind that they are unintelligible, impracticable, absurd; and, consequently, that the whole pretended system of physiology from which they are deduced, is equally unworthy the dignity of reason.

350⅔, *a*. I shall now employ the same authorized chemist (§ 349, *d*) to give the last blow to his baseless fabric, and to scatter its fragments beyond the reach of idolatry itself. This will be done by setting forth, in the language of the author, his deductions from the physiological and pathological doctrines of the laboratory, as to

The Chemical Treatment of Disease (§ 350, no. 59).

"The accelerated change of matter, and the elevated temperature in diseased parts, show that the resistance offered by the vital force to the action of oxygen is feebler than in the healthy state. But this resistance only ceases entirely when death takes place (nos. 1, 46). By the artificial diminution of resistance in another part (as by blisters, sinapisms, or setons), the resistance in the diseased organ is not, indeed, directly strengthened; but the chemical action, the cause of the change of matter, is diminished in the diseased part, *being direct-*

ed to another part, where the physician has succeeded in producing a still more feeble resistance to the change of matter, TO THE ACTION OF OXYGEN.

350⅔, *b.* "A complete cure of the original disease occurs, when external action and resistance, in the diseased part, are brought into equilibrium. Health, and the restoration of the diseased tissue to its original condition, follow, when we are able so far to weaken the disturbing action of oxygen, by any means, that it becomes inferior to the resistance offered by the vital force, which, although enfeebled, has never ceased to act; for this proportion between these causes of change is the uniform and necessary condition of increase of mass in the living organism."

350⅔, *c.* "In cases of a different kind, where artificial external disturbance produces no effect, the physician adopts other indirect methods to exalt the resistance offered by the vital force. He diminishes, by blood-letting, the number of the carriers of oxygen (the globules), and, by this means, the conditions of change of matter; he excludes from the food all such matters as are capable of conversion into blood, &c.

350⅔, *d.* "If he succeed, by these means, in diminishing the action of oxygen in the blood on the diseased part, so far that the vital force of the latter, its resistance, in the smallest degree, overcomes the chemical action; and if he accomplish this without arresting the functions of other organs, then restoration to health is certain. [!]

350⅔, *e.* "Practical medicine, in many diseases, makes use of *cold* in a highly rational manner, as a means of exalting and accelerating, in an unwonted degree, the CHANGES OF MATTER. This occurs especially in certain morbid conditions, *in the substance of the centre of the apparatus of motion;* when a glowing heat and a rapid current of blood toward the head point out an abnormal METAMORPHOSIS OF THE BRAIN [!] (350, motto *i*, nos. 3, 5). When this condition continues beyond a certain time, experience teaches that all motions in the body cease. [!] If the change of matter be chiefly confined to the brain, then the change of matter, the generation of force, diminishes in all other parts. [!] The *metamorphosis* which decides the issue of the disease is limited to a short period. We must not forget that the *ice melts* and absorbs heat from the diseased part; that if the ice be removed before the completion of the *metamorphosis*, the temperature again rises; that *far more heat is removed from the head than if we were to surround the head with a bad conductor of heat.* There has obviously been liberated, in an equal time, a far larger amount of heat than in the state of health. [That is to say, such is the pathology of cerebral inflammation, such the remedy, and such its modus operandi.]

350⅔, *f.* "The self-regulating steam-engines, in which, to produce a uniform motion, the human intellect has shown the most admirable acuteness and sagacity, furnish no unapt image of what occurs in the animal body.

"Every one knows, that in the tube which conveys the steam to the cylinder where the piston-rod is to be raised, a stop-cock of peculiar construction is placed, through which all the steam must pass. By an arrangement connected with the regulating wheel, this stop-cock opens when the wheel moves slower, and closes more or less completely

when the wheel moves faster than is required for a uniform motion When it opens, more steam is admitted (more force), and the motion of the machine is accelerated. When it shuts, the steam is more or less cut off, the force acting on the piston-rod diminishes, the tension of the steam increases, and this tension is accumulated for subsequent use. The tension of the vapor, or THE FORCE, so to speak, is PRODUCED BY CHANGE OF MATTER, *by the combustion of coals in the fire-place.* The force increases (the amount of steam generated and its tension increase) with the temperature in the fire-place, which depends on the supply of coals and of air (§ 433, &c.). There are in these engines other arrangements, all intended for regulation. When the tension of steam in the boiler rises beyond a certain point, the passages for admission of air close themselves; the combustion is retarded, the supply of force (steam) is diminished. When the engine goes slower, more steam is admitted to the cylinder, its tension diminishes, the air-passages are opened, and the cause of disengagement of heat, or production of force, increases. Another arrangement supplies the fire-place incessantly with coals in proportion as they are wanted.

"If we now lower the temperature at any part of the boiler, the tension within is diminished. This is immediately seen in the regulators of force, which act precisely as if we had removed from the boiler a certain quantity of steam, or force. The regulator and the air-passages open, and the machine supplies itself with more coals.

"*The body, in regard to the production of heat and force, acts just like one of these machines.* With the lowering of the external temperature, the respirations become deeper and more frequent; oxygen is supplied in greater quantity and of greater density, the change of matter is increased, and more food must be supplied, if the temperature of the body is to remain unchanged."—LIEBIG'S *Animal Chemistry.*

Here ends the science of *therapeutics*, as founded upon the preceding doctrines in physiology and pathology; and as the whole system is comprehended within the limits of the last three pages, the reader will readily contrast its brevity with the labors of the past, and will not fail to discover in this time-saving, thought-saving attainment of medicine, as well as in the impenetrability of the system itself, and the unequaled confidence with which it is set forth, the main causes of its success.

I shall now proceed, as proposed in § 350¼, to demonstrate by the farther showing of chemistry itself, that physiology and medicine have little to hope from the laboratory of the chemist.

350¾, *a*. Of the school of pure chemistry, and of an authority approaching to Liebig, is the distinguished Professor Mülder; less inconsistent than Liebig, but compelled to admit the existence of peculiar forces in living beings, yet positively denying them. He advocates, after the manner of Prichard, Carpenter, Fletcher, &c., the existence of all the properties of living beings in the elements of matter, which conducts him, like others, to the belief in Equivocal Generation; adopts the *Catalytic theory* of Berzelius, in which he differs fundamentally from Liebig (§ 409, *j*); reasons, after the usual manner of the physical philosophers of life, from the results of inorganic processes, and overlooks entirely, except by admission of their existence, all the unique phenomena of living beings, and, perhaps, more than

any author of merit, is guided in his conclusions as to the processes and results of organic beings by the fallacious analogies which are studiously sought in the inorganic world. The whole system of vital philosophy, as taught by this distinguished Professor of *Chemistry*, may be so briefly set forth in extracts from his work on "The Chemistry of Vegetable and Animal Physiology," and they convey so forcibly the conjectural nature and worthlessness of chemical physiology, that the selection will contribute its important part toward the final expulsion of chemistry from the rich and fascinating domain of organic nature. The quotations will be made in the order of their occurrence in the work; and we learn from the first the author's opinion of *force*, which corresponds with my own as employed in the *Commentaries*, and as defended in my *Examination of Reviews*. Thus:

350¾, *b*. "It is a matter of indifference whether we conceive that the *forces slumber* in two substances, and are brought into operation by contact; or that these forces were present in the two bodies in an *active* state, *previous* to the contact, but produced the phenomena of combination only *during* the contact. The mode of considering this point is almost a matter of indifference; but we must always bear in mind that it is a *power*, a *force* which is exerted by the one, and which acts upon the other."—MÜLDER.

350¾, *c*. The next quotation is preliminary to the total denial of the Principle of Life, and of all the properties in living beings excepting such as are active or "*slumbering*" in the elements of matter. Here, too, appears the fallacy of analogies derived from the laboratory of the chemist. Thus:

"Adhering to what we observe and know with certainty, we calculate that every elementary body is endowed with a great many specific properties, which, to a large extent, are dependent on the same principle that causes their combination, and thus on the proportion and character of the *chemical tendency*. If we adopt this idea, we have the advantage of seeing somewhat of VITALITY IN DEAD MATTER. [!] IT IS AN IDEA DERIVED from the endless series of phenomena which are observed IN THE LABORATORY, in daily occurrences, and in nature at large" (§ 175, *d*).—MÜLDER.—(§ 1034, LEHMANN).

350¾, *d*. After the usual disquisition upon the "catalytic action" of platinum and other inorganic substances, we come next to the same application of *catalysis*, in connection with the ordinary laws of chemical affinity, to the interpretation of organic processes and results, as I have examined in the "*Commentaries*" (vol. i., p. 55–78). It comprehends Mülder's whole theory of life, and is a good specimen of the author's analogical reasoning. Thus:

"Platinum possesses chemical tendency in a high degree; but it is of such a kind, that it does not react upon the platinum. Hence it may be inferred, that we have good reason for distinguishing by a peculiar name such actions as proceed from certain substances without reacting upon themselves; and we have to acknowledge that to the introduction, by Berzelius, of the peculiar term *catalysis*, we are indebted for a more correct idea of the nature of ordinary chemical action.

"What is called the *nascent state* of substances is that condition of the *elements* in which they exhibit both *analytic* and *catalytic* phenomena; in which, being free and unconstrained, not rendered powerless

either by being agglomerated into masses, or by combination into compounds, they show themselves in their proper *chemical* condition; that is, an active one, in which they can operate upon others, excite a slumbering energy, and cause combinations and decompositions, in which they themselves may either participate or not. This *nascent* state is the *real chemical* state of bodies. In that state both the elements and compounds exhibit themselves in their true character. In the organic kingdom the greater number of substances are actually in that condition; and to *this nascent state* we ought to ascribe the *numerous peculiar* phenomena apparent in *organic* substances" (§ 409).—MÜLDER.—(§ 1034, LEHMANN).

350$\frac{3}{4}$, *e.* The next quotation sets forth the whole practical application of the foregoing doctrines, and is a fine example of the chemical reduction of organic nature to the condition of dead matter, and one of the best summary exhibitions of chemistry in all its pretended relations to living beings. It begins with the caption

"*Disturbance of Chemical Equilibrium.*"

"It is a property of the *chemical forces,* when active in any substance, to excite analogous forces in others. We notice this especially in *organic nature*, and it is nowhere more strikingly illustrated than in the NUTRITION of animals. Blood, a HOMOGENEOUS fluid, circulates through very different parts of the body (§ 42). In the muscles it sustains muscles, in the liver it supplies the component parts of the liver, and from it the gall is there secreted; in the kidneys it maintains their various parts, and secretes the urine, &c. *None of these secretions appear in the blood with their peculiar qualities; of some of them not even a trace is found.* But the four organic elements of the whole are to be found in protein and its combinations, in the coloring matter of the blood, &c. The elements of protein might, no doubt, be transposed in the liver, &c., by means of catalysis, and so the component parts of the liver and gall be produced from it. It would only be necessary, then, that the constituent parts of the liver should be put into contact with the component parts of the blood, and the forces of affinity resident in the substance of the liver would not require to influence those in the protein, or to produce any chemical alteration in its component parts.

"Other causes, however, ought undoubtedly to be considered. For instance, a change of its component parts takes place in the liver itself, and, from the first, chemical forces actively operate therein. For the continual change of its component parts is a chief characteristic of every living organic substance. These forces may disturb the chemical equilibrium of other substances, and cause the formation of new products. If the constituents of the blood—the combinations of protein, the coloring matter, &c.—enter the liver when it is in a state of action, and are there put in contact with the gall during its secretion, and with the substance of the liver itself, which is in a state of continual alteration, then the result will be, that this change of their component parts having taken place, the action will be transferred to the elements of the blood, and will maintain the secretion. If, on the other hand, the constituents of the blood are in a state of continual change, then the circle of action in which they are involved will extend to the mass of the liver; and so with every organ (§ 18).

"We have, however, no more knowledge of the manner in which this secretion originally commences—whether it proceeds from the blood or from the secreting organ, [!] or whether each of these contributes its part—than with the manner in which the first germ of the whole organ, the liver, is produced, or in which the germ of the animal is converted into an animal. But the continuance of the action—the duration of secretion—entirely corresponds with some other phenomena, which we may observe separately, and which therefore throw light upon these animal actions. This is the case especially with *fermentation*, from which Liebig has drawn many illustrations, for the purpose of clearly exhibiting his ideas; and with the same view we shall also avail ourselves of this process.

"Yeast changes sugar into carbonic acid and alcohol, and is at the same time changed itself. The latter change causes the former, and is only transferred to the sugar. If we substitute *blood for yeast*, and the *liver for sugar*, we may form an idea, more or less distinct, of the *secretion of the gall.* [!] The component parts of the blood are continually undergoing change. This constant change of the component parts in organic bodies is a chief cause of the continuation of their existence. The liver without intermission assumes new parts and loses others. This process we call nutrition. At the same time that the parts of the blood in the substance of the liver are thus undergoing change, chemical forces are excited; these forces are transferred to the elements of the blood, and so are enabled to produce from them the gall. This takes place the more easily, as the blood itself is also in a state of continual alteration, and thus readily yields to the impulse which, in some way or other, is communicated to it. As the impulse varies, so does the effect. Hence that great diversity in the secretion of very dissimilar substances, which are in a state of alteration, from the same fluid—that is, the blood, which is itself at the same time in a state of decomposition."—MÜLDER.

350¾, *f.* In our next quotation we have an assumption founded on a begging of the very question at issue; that is to say, whether there be or not a radical difference in the original constitution of organic and inorganic nature. The author having assumed that there is no difference, proceeds, by the force of surmised analogies drawn from the probable constitution of inorganic matter, to repeat the assumption already stated that there are no other properties in living beings than such as exist in the elements of matter. Thus:

"The idea of *communication of forces* is unsound; it is only what is substantial that we can communicate. Forces may be *excited*, they cannot be *communicated.* Hence it results that every transformation in plants is effected by the molecular forces of carbon, hydrogen, oxygen, and nitrogen,—the elements of carbonic acid, water, and ammonia,—the forces being excited in these elements by the plants themselves." "Any one who imagines that there is any thing else in action than a molecular force, than a CHEMICAL FORCE, *sees more* than exists. The *forces excited in the elements* vary with the influence which certain agents—temperature, moisture, light, &c.—exert. By the aid of crucibles and retorts, therefore, compounds can be formed which differ from those produced by the organs of plants; while, from carbonic acid and water, plants can produce *cellulose* and oxygen, a result which CANNOT YET be imitated by art." "To express our idea in a

few words:—The elements of the organic kingdom, carbon, hydrogen, oxygen, and nitrogen, are susceptible of endless modifications For that reason they can form, with minute changes, a great diversity of products (§ 41); and by the operation of the same *primary* forces, they stand toward each other *in entirely different relations from those assumed by all the other elements;* so that THEY CAN PRODUCE *a peculiar series of bodies, which are called organic substances*" !* "Organic substances, whether called germs or food, possess properties of a PECULIAR KIND, EXISTING IN THE FOUR ELEMENTS of which they are all constituted" !—MÜLDER.

350¾, *g*. The difficulty, therefore, with the chemists appears to lie in their habits of reasoning exclusively from what they observe of inorganic compounds and their elements, and an indisposition to admit that the Almighty superadded to organic beings a principle of life, while they allow the special creation of mind in animals. Nor does their philosophy permit them to imagine that the former may be as capable of governing all the processes of organic, as the latter is of animal life, and that the principle of life may be supposed, with as much reason as the principle of intelligence, to be imparted by the exact organization perpetuated from the Almighty Hand to new accessions to that organization; while the phenomena of life are far more multifarious and conclusive of the existence of a special principle than such as oblige the chemist to yield his assent to a mental principle distinct from the matter with which it is associated. Why, then, does not the chemist equally maintain the existence of mind, as of the properties of life, in the elements of matter, and that its development is alike owing to a difference of circumstances? Does he fear that this stretch of materialism, this act of philosophical consistency, or his neglect to abjure the obvious inference, may impair our confidence in the apparently though not really less objectionable scheme of reducing organic life to the virtual condition of the simple elements of matter, and thus fail of inculcating the most dangerous atheism by attributing creative power to those elements (§ 14, *c*)?

350¾, *gg*. But let us hear the chemist upon this interesting point. And Liebig, first; who, also, shall show that no injustice is done by the preceding remarks. Thus:

"The higher phenomena of mental existence cannot, in the present state of science, be referred to their *proximate, and still less to their ultimate* causes. We *only know* of them that they exist. We ascribe them to an *immaterial agency*, and that, in so far as its manifestations are connected with matter, an agency entirely distinct from the vital force, with which it has nothing in common."—LIEBIG'S *Animal Chemistry*.

"Physiology has sufficiently *decisive grounds* for the opinion that every thought, every sensation, is accompanied *by a change in the composition of the substance of the brain;* that every motion, every manifestation of force, IS THE RESULT *of a transformation* of the structure or of its substance."—*Ib.*

"Thought, sensation," &c., are "*manifestations* of force," and are, therefore, "the *result* of," &c. See PARALLELS, p. 158, no. 5½.)

And now the other able and distinguished chief:

* See my "*Notice of Reviews*," ut cit., and my "*Examination of Reviews*," p. 43, 44, in "Commentaries," vol. iii.

"I will not *venture* to raise the veil, by which the ACTION OF THE NERVES, or the HIGHER FUNCTIONS OF THE MIND, have hitherto been shrouded from observation. As man HAS AN IMMATERIAL and immortal part, *which is identical with his real being*, and of which alone he will consist, when the material frame by which he is bound to the earth, shall be dissolved; and, as the inferior animals possess, in common with man, certain powers of perception, associated with certain appropriate organs, whose functions have no connection with consciousness; so do animals and plants perform in common a great many operations which are distinct from BOTH of those now mentioned, or which, at least, have their origin in DISTINCT CAUSES.

"It is only the LATTER CLASS of which I speak, and to which I apply the general term of *organic life*. To that subject I shall restrict my remarks."—MÜLDER, *ut cit.*

Now, I say, 1st. Why not "raise the veil from the *action of the nerves*" in a professed work on physiology, and a work, too, which would revolutionize the science? Have you no phenomena to guide you in "raising the veil?" Do you fear their contact with the phenomena of the laboratory? Is it right to make this declaration, and then to refer a vast series of phenomena exclusively to "organic life," which could have had no existence without the "action of the nerves" (see § 350, no. 18½)? I deny, too, 2d, that "the higher functions of the mind have hitherto been shrouded from observation;" and I am supported by all who truly believe in the independent existence of mind, in the affirmation that its "functions" are characterized by an infinitely greater variety of unique phenomena than are the processes of inorganic nature. There is no "veil to be raised" in this or the other case. It is, indeed, by the recognition of these phenomena that our author feels obliged to admit the existence of "an immaterial part," however inconsistent the simultaneous declaration that "the functions of the mind have hitherto been shrouded from observation." And, I am alike sustained, also, and by every dictate of philosophy, in the conclusion that, if the phenomena of mind are decisive of the existence of "an immaterial part," so are the far more varied, and numerous, and equally unique phenomena of organic processes, conclusive of the existence of some not less peculiar force, power, or "immaterial" or *material* "part," upon which they depend. In any event, however, the physiologist has a right to insist that the chemist shall not reject all considerations relative to the "*action of the nerves*," when he invades organic nature with retorts, crucibles, acids, &c.

"Analogy is," undoubtedly, as Bacon says, "the basis of all the sciences." Nature, throughout, is bound together by analogies. The principle reaches from the Creator to the mind of man, to his "immaterial and immortal part." And so it does from the force and the properties of life to those of dead matter. Here is the delusion of the chemist. But, there is even a wider difference between the *formative principle of life* and *destructive chemical affinity*, than there is between the Creative Spirit of God and the created, dependent spirit of man (§ 1076).

350¾, *h.* The grand characteristic of organic life is *the principle of life*, capable of imparting that principle to matter which is destitute of it, and which it retains only while in its proper connection with the being by which it was so endowed. The doctrine which refers the

properties of life to the elements of matter is *atheistical* in its application (§ 14 *c*, 74, 175); and the recognition, simultaneously, of a "Creative Power," is but another *conventional* word for *nature*, or designed to protect the doctrine against the fatal imputation of irreligion (§ 64, *h*). That imputation, however, is indelibly stamped by nature herself. The mode of defense is well shown in the late highly lauded and popular work on the "VESTIGES OF THE NATURAL HISTORY OF CREATION," in which the author considers La Place's infidelity as to the *modus operandi* of matter in forming the Universe, and the doctrine of spontaneous generation in its most ample extent. The author's defense of Mr. Crosse's creation of animals out of silex is a good example of the specious reasoning by which so many are cheated into projects which contemplate the worst results to philosophy and religion.* Thus:

350¾, *i*. "The supposition of impiety arises from an entire misconception of what is implied by an aboriginal creation of insects. The experimentalist could never be considered as the author of the existence of these creatures except by the most unreasoning ignorance. The utmost that can be claimed for, or imputed to him, is, that he arranged the natural conditions under which the true creative energy, that of the Divine Author of all things, was pleased to work in this instance. On the hypothesis here brought forward, the ACARUS CROSSII [!] was a type of being ordained from the beginning, and destined to be realized under certain physical conditions. When a HUMAN HAND brought these conditions into the proper arrangement, it did an act akin to hundreds of familiar ones which we execute every day, and which are followed by natural results, but it did NOTHING MORE." The defense of La Place's system proceeds upon the same specious assumption (p. 910–911, § 1083, p. 921–928, § 1085).

Now the foregoing doctrine transcends not only the usual geological hypothesis of a successive creation of animals, but that, also, of spontaneous generation; both of which are, of course, anti-Mosaic, and regardless of the established order of creation (§ 303 *a*, 303¼). But here we have an exemplification of a strictly atheistical expedient, in the attempt to assign the existence even of organic beings to the merest chance, under the pretext of ascribing to that chance the intrinsic attributes of a Creative Power, and the imposing title of "the Divine Author of all things"! It is the same with each and all who allow a God, a Creator, &c., yet reject entirely His Revelation as to creation, supported as it is by the most consummate and endless systems of Design. It is the old expedient of the wolf in the disguise of the sheep (§ 14 *c*, 64 *h*, 74, 733 *d*).

350¾, *k*. Nevertheless, the foregoing work is powerfully sustained by able articles in the BRITISH AND FOREIGN MEDICAL REVIEW for January, 1845, consisting of twenty-six pages of eulogistic remarks; and in the MEDICO-CHIRURGICAL REVIEW for the same month, of ten pages not less congratulatory. The work was published late in 1844, and, although not at all relevant to medicine, it was taken up with avidity by the two leading medical journals of Europe, and an effort

* See *Medical and Physiological Commentaries*, vol. i., p. 707; vol. ii., p. 96. In vol. i., *Grass* is a typographical error for *Crosse*. It is also possible that the "created animals," instead of being "crystalized spiculæ," were real animals evolved by the action of galvanism from ova contained in the water (see § 74, 188½ *d*).

made to prepossess the medical profession before the work itself should fall under their observation; observing in this respect the system which was almost universally pursued by the periodical press even in anticipation of Liebig's work on *Animal Chemistry*.

In my Essay on *Spontaneous Generation*, embraced in the *Medical and Physiological Commentaries*, I have had occasion to refer to the charge of infidelity which is often laid against the Medical Profession. I have there, too, defended that Profession against so great an injustice, and have held responsible the proper Sources that have given rise to this imputation. I have also shown that that imputation is greatly due to the cultivation of the chemical and physical hypotheses of life, to which the foregoing Reviews have been laboriously devoted. In conclusion of the whole matter I have said that,

"The steps are gradual from the incipient errors in natural philosophy to a disbelief in the Mosaic Record of Creation. When we have ultimately reached the brink of the precipice, there is but one dreadful plunge, and we are then in the vortex of atheism. We may begin, as I have said, by a simple denial of the living powers of organized beings, when it will become, at last, an easy argument upon this, and analogous premises, that the Almighty had but very little, if any agency, in the most sublime part of existences."

"Let *philosophy* interrogate nature to its fullest satiety, under the direction of its Heaven-born principles; but let it be consistent, and maintain its dignity. And should it sometimes, as it must in its wide range of nature, come in contact with miracle, that is its limit, contented that it begins at the confines of Creation; yet still may it stretch into the regions of Eternity, past and to come; but now it is employed in its nobler work of sacrificing its relations to second causes, and in establishing relations with the First Cause of All." —*Medical and Physiological Commentaries*, vol. ii., p. 140.

350¾, *kk*. It is now my purpose to quote the foregoing Reviews in connection with the "Vestiges of Creation," partly for the object just assigned, and in part to supply other examples in justification of what I have said in behalf of the Profession, and of the tendency of the chemical and physical hypotheses of life and disease to lay the foundation of a grosser materialism, and of infidelity in Religion (§ 175). It seems peculiarly appropriate that Reviewers, who wield an extensive and powerful sway, and whose occupation it is to defame whatever molests that dominion, should be used for the contemplated purpose, and this, more especially, as both Reviewers offer defiance to the "Saints," and the "timid religionists." The Reviews are conducted with great diligence and research. Their influence is coextensive with medicine. That influence must be sapped by a display of its tendencies. There can be no difficulty with a defense of the right. The inculpated are able, their means ample, their coadjutors numerous and powerful, the public generous, and, as I said on a like occasion in the *Commentaries*, "I am single-handed, and have nothing but facts for my weapons" (vol. i., p. 391).—Note W p. 1127.

Infidelity is certainly a term which should be well sustained in its application; better, at least, than when applied to myself by the first of the following journals (see *Examination of Reviews*, p. 84–88). As it respects the Reviewers, the imputation appears to be invited and expected, as an obvious consequence of the doctrines advanced;

and, although I do not belong to the denomination of "Saints," or of the "timid religionists," it is not less my duty as a man, and as an expounder of the Institutes of Nature, to bring those institutions to operate upon infidelity. There can be no place more appropriate for looking "through Nature up to Nature's God," than in the general survey of organic beings. If ordained in their organization and their laws by a higher Power, that organization and those laws may well be urged in proof of their Origin. Then, too, shall the minister of health realize the importance of the Institutes of Medicine, and the spirit of the Hippocratic maxim, that "a philosophical physician is like a god."

I shall quote a passage of general import from each of the foregoing Reviewers, that no doubt may linger upon the mind of any reader as to the justice of the criticism which I have now exercised in behalf of religion, of morality, of the dignity of medicine. The *emphasis* is mine.

And first the elder brother; beginning thus:

"This is a remarkable volume, small in compass, but embracing a wide range of inquiry from worlds beyond the visible starry firmament, to the minutest structures of man and animals. No name is prefixed,—perhaps in order to avoid the snarls of the narrow-minded and bigoted SAINTS of the present day," &c.

The middle thus:

"For how many millions and millions of years this production and reproduction of animals went on before man made his appearance on the scene, no human being will ever know. [!] In all probability, countless ages must have elapsed, before this master-piece of creation appeared. Our author's speculations on the *how*, the *why*, the *when*, and the *wherefore* this great event occurred, will not give satisfaction to the *present* RACE of mankind. [!] His hypothesis is three or four centuries in advance of the TIMES, and will be stigmatized by the modern SAINTS as downright atheism," &c.

And the end, thus:

"We have dedicated a space to this remarkable work that may induce many of our readers to peruse the original. The author is decidedly a man of great information and reflection. He will have a host of SAINTS in array against him, and many will join in the cry, *from hypocrisy and self-interest*. As we said before, his doctrines have come out a century before their time."—MEDICO-CHIRURGICAL REVIEW, p. 147, 153, 157. *London*, Jan., 1846.

Next, Dr. FORBES, in the *British and Foreign Medical Review*.

"This is a *very beautiful* and a *very interesting* book. Its theme is one of the grandest that can occupy human thought,—no less than the CREATION OF THE UNIVERSE." "We are also influenced by the abstract desire to place before our readers matter for their contemplation, which cannot fail at once to *elevate*, to *gratify*, and to *enrich* the mind. It has always been one of the boasts of our noble profession that it touches and blends with every science; and we should be sorry that our humble efforts should at any time be wanting to stimulate its professors to exertions that might still justify the boast"!

Of La Place's nebular hypothesis, he says:

"So far from admitting the atheistical tendency which TIMID RELIGIONISTS have attributed to the nebular hypothesis, *we consider it the grandest contribution which Science has yet made to Religion*," &c.

The reader, therefore, will have no difficulty in understanding the "conventional" nature of certain phrases in the following remarks by Dr. Forbes. (See *h*.)

"That the Creator formed man out of the dust of the earth, we have *scriptural* authority for believing, and we must confess *our own predilection* for the idea, [!] that, at a period however remotely antecedent, the *Creator* endowed certain forms of inorganic matter with the PROPERTIES REQUISITE TO ENABLE THEM TO COMBINE, AT THE FITTING SEASON, INTO THE HUMAN ORGANISM, [!!] over that which would lead us to regard the great-grand-father of our common progenitor as a chimpanzee or an orang-outang."—BRITISH AND FOREIGN MEDICAL REVIEW, p. 155, 158, 180. *London*, January, 1846. (See *l*.)

The author of the *Vestiges of the Natural History of Creation* is thus quoted by Dr. Forbes:

"We have seen powerful evidence that the construction of this globe and its associates, and, inferentially, that of all the other globes of space, was the result, not of any immediate or personal exertion of the Deity, but of NATURAL LAWS which are expressions of His will. What is to hinder our supposing that the ORGANIC CREATION is also a result of NATURAL LAWS which are, in like manner, an expression of His will?"—NATURAL HISTORY OF CREATION.

Upon the foregoing extract, which is a part of a more extended one of the same nature, Dr. Forbes remarks, that,

"The COMPLETE ACCORDANCE OF THESE VIEWS with those some time ago PROPOUNDED BY OURSELVES (vol. v., p. 342), must be evident, we think, to our readers. To the objection which some TIMID RELIGIONISTS may urge against them, that they are inconsistent with the Mosaic record, we simply reply with our author, that we do not think it right to ADDUCE THAT RECORD either IN SUPPORT OF, or in objection to, *any scientific hypothesis*, based upon the phenomena of nature," &c.! —BRITISH AND FOREIGN MEDICAL REVIEW, p. 167.—NOTE Pp p. 1142.

Dr. FORBES assumes, of course, that all the misapprehensions and perversions of "the phenomena of nature" are paramount to any thing declared in the Mosaic Record (§ $5\frac{1}{4}$, 74, 733 *d*, 1079 *b*, 1085).

The most superficial reader cannot fail of discerning in the foregoing principles, as in many other analogous instances, the motives which have induced those foremost medical Reviews to lend their powerful aid in propagating the materialism of Carpenter, the absurdities of Liebig, the humoralism of Andral, and the putrid anatomy of Louis, and of their respective schools; and why, on the other hand, they have been equally regardless of truth in their vocation as critics on the labors, the researches, and the statements of others.—NOTE W $350\frac{3}{4}$, *l*. I have already shown in this and other works how convenient a matter it is for "the properties of life in the elements of matter" to bring these elements into an organic state. And since I am now on the subject of the first and greatest step in the process of *vivification*, it may be useful, as it is appropriate, to show how the advocates of "the properties of life in the elements of matter," and the propagators of spontaneous generation, and eminent geologists who promulgate a successive creation of animals according to their scale in organic nature and in conformity with the development of new physical agencies, ay, and certain eminent vitalists whose otherwise sound philosophy should have enlightened them as to the Great First

Cause—in view of all these things, I say, it may be conducive to sound physiology to show how the foregoing schemers of "creation" arrive, in part, at least, at the conversion of organic matter into the complex fabric, after that matter shall have been duly compounded by "the properties of life which reside in the elements." For this purpose I will take the statement of the distinguished vitalist Tiedemann. Thus,

"The most probable hypothesis is, that the *substance* of organic bodies existed primitively in water, as matter of a particular kind, and that it was *there endowed with the plastic* faculty; that is to say, with the power of acquiring, by degrees, different simple forms of living bodies, with the concurrence of the general influences of light, heat, and perhaps also of electricity, &c., and of then passing from the simple forms to other more complicated; varying in proportion to the modification occurring in the external influences, until the point when each species acquired duration by the production and manifestation of activity of the genital organs" !—TIEDEMANN'S *Physiology of Man.*

That is the doctrine, candidly avowed by those to whom genius and the conviction of a right discernment of the ways of nature impart a fearless independence, however it may be disguised by others under the "conventional term" of *creation.* But, Tiedemann is a philosophical vitalist, and did not confound the principle of life with the forces of inorganic matter, nor, like Carpenter, Fletcher, Prichard, Roberton, Forbes, &c., place the properties of that principle in the elements of matter. He started with matter in more or less of an organic state, and leaves it problematical how its elements became united into that peculiar vital compound. He did not even imply that the elements being so endowed could organize themselves, for he adds to the foregoing statement, that,

"Although we cannot here answer the question, *whence* came the water and the *organic* matter which it contained, yet this hypothesis is the one which accords best with *the facts with which geology has lately been enriched.*" And again, "If it be asked, *whence organic matters proceed, how* they are produced, together with *the power of formation inherent in them*, we are necessitated candidly to confess our ignorance on the subject, inasmuch as the *first origin* of organic matters and living bodies is altogether beyond the *range of experiment.*"—TIEDEMANN'S *Physiology of Man*, p. 14, 193.

It will be thus seen that even Tiedemann's doctrine enjoys "a loophole" which cannot be allowed to those who place "the properties of life in the elements of matter," or who endeavor, or propose, to create organic compounds in the laboratory of the chemist; since, in respect to the latter, were the production of *organic compounds* within "the range of experiment," the accidental nature of the origin of such compounds, and, therefore, the incipient being of man, would be established by the laboratory. And now I ask, does not the organic chemist attempt or profess to create organic compounds? So says Liebig, § 350, no. 39, and so say most other distinguished chemists. Liebig and his disciples create the *compounds;* Crosse and his followers create the *animal.* Others do but make the *attempt;* and this is a very numerous class who thus enter into competition with the ORIGINAL AUTHOR of organic compounds. What, therefore, is the difference in principle between him who pretends to have succeeded

in this work of creation, and the other who has attempted the work, but without success?

From the physiologist who advocates the existence of "the properties of life in the elements of matter," we hear that,

"There is no reasonable ground for doubt that if the elements could be brought together in their requisite states and proportions *by the hand of man*, the result (artificial organic compound) would be *the same* as the *natural* compound." Again, "that the *germs* (of parasitic plants and animals in the interior of others) have been conveyed *from without* into the situations where they are developed, must be held as a *very forced supposition*"!—CARPENTER'S *Principles of General and Comparative Physiology*, p. 146, 395; *also, this work*, § 14 *c*, 175 *c*, *d*, 189 *b*.—See doctrine of "Development" p. 922, and NOTE PP p. 1142.

350¾, *m*. Mülder has the manliness to carry out the obvious tendency of his doctrines, which may be expressed in a brief quotation. Thus,

"Upon the principles which have been stated, no room is left for the dispute as to *equivocal generation* and *epigenesis*." Nevertheless, it is allowed by Mülder that cellular structure "cannot *yet* be imitated by art." But, waving this conceded difficulty, if the physiological arguments which I have advanced in section 14 *c*, as to a real Creator, can be invalidated, I shall concede that a ground has been obtained for the doctrine of spontaneous generation (§ 1051, p. 922, § 1085).

350¾, *n*. As I shall soon dismiss this author, it may be useful, in consideration of his exalted worth as a chemist, and his authority among physiologists, to show that even one who endeavors to hold a consistent philosophy on the subject of chemical physiology, yet sees in organic beings so much to contradict his chemical doctrines, that he evinces the usual inconsistency of those who have endeavored to confound the science of life with that of chemistry (§ 4½, *d*). For this purpose I shall select two passages only, and place them in parallel columns, after the manner adopted in relation to Liebig in section 350. I shall elect, also, for the *negative* side, a passage which will show, what cannot be too often repeated, that the chemists are absolutely regardless of their own fundamental doctrine, of "ascending from phenomena to their causes," by rejecting all the unique phenomena of life as indicative of any peculiar force or laws. The *affirmative* side, however, is all that the vitalist desires (§ 189).

Denial of the Vital Principle and Vital Properties.	*Recognition of the Vital Principle and Vital Properties.*
"Wherever forces are found in organic nature, there are substances which are all supplied with molecular CHEMICAL FORCES. Even those singular structures, the nerves, consist of the same elements as the ordinary substances of the organic kingdom. It is thus undeniable, that the MOLECULAR FORCES act a chief part in the organism, so far as a change of substances takes place therein;	"The question is, whether, during decomposition, the ORGANIC FORCES grow weaker of themselves, permitting the elements to obey their *primary tendency*,—or whether causes must exist by which these ORGANIC FORCES are made weaker? Neither is improbable. Every thing which ceases to be subject to the VITAL PRINCIPLE, becomes incapable of being stimulated by the VITAL

and that NO GENERAL, NO VITAL FORCE, should be assumed as the source of those molecular forces. Such a vital force is irreconcilable with the true principles of science, which require that nothing should be *assumed* as existing, but that every thing should be *sought for* in nature; which teach us to ascend only from an unprejudiced consideration of the phenomena to their causes, and to assign those causes only as we deduce them from the observed phenomena." —MULDER'S *Chemistry of Vegetable and Animal Physiology*, p. 68. 1845.

FORCES;—it is placed in other circumstances; and as the PRODUCTS OF THE VITAL FUNCTIONS ARE DIFFERENT FROM THE PRODUCTS OF INORGANIC NATURE, in consequence of the very difference of the circumstances in which the elements are placed, so the products of substances, deprived of VITAL INFLUENCE, must also GREATLY VARY with circumstances. Hence it may happen, that THE FORCES present in organic substances, when deprived of the VITAL INFLUENCE, may DISAPPEAR of themselves. The impression they had at first received is changed, modified, OBLITERATED and therefore the effects can no longer be the same. A substance persists in the state into which it was *first put*, according to the law of INERTIA; but the maxim, *sublata causa tollitur effectus*, is of EQUAL VALUE."—MÜLDER'S *Chemistry of Vegetable and Animal Physiology*, p. 54 (§ 59).

I shall conclude with an extract from Mülder, in which it will be seen that he has adopted the method set forth by myself in my *Essay on the Philosophy of Vitality*" (1842), of investigating the subject in the development of the germ. It may be useful to place in contrast the purely chemical and the purely vital interpretations of that development (§ 65). I may also premise that it should be observed that the chemist keeps out of view all the remarkable circumstances attending the development of the egg which I have set forth as irreconcilable with chemical phenomena, and limits himself to statements founded on a supposed analogy with the simple results of chemical affinity as observed in inorganic nature. Thus:

"If we review the phenomena of life, caused by change of materials, we must go back to the original formation of organs—to the growth of an individual from a germ." After illustrating the development of the germ by "an example from the inorganic kingdom" (the formation of prisms from a solution of the sulphate of soda!), this distinguished chemist proceeds to say, that

"Undoubtedly the differences which exist between the particles of the same organic substances are not chemical, in the ordinary gross signification, but are of the nature of those which are connected with polymorphism. The chemist gives us but a rude result—the composition in a hundred parts, frequently not affording us any insight into either the real characters of substances, or into their real differences. Whenever such dissimilar particles come together, a compound must be produced, possessing peculiar forces, which, though dependent upon

the molecular forces of the elements, are yet not determined by these alone. The new arrangement causes a modification of those primary forces. Whenever it takes place, they appear modified, and therefore indicate their presence by producing new effects. In sulphate of soda, the whole collected forces of its constituent molecules—those of sulphur, sodium, and oxygen—are still existent; and upon these alone depend its qualities, composition, and crystaline form. Sulphate of soda cannot possess other qualities—cannot become other in property—than what results from its elements, and exclusively originates in these.

"Thus, then, we suppose that the molecules of the substances in the embryo are arranged, in the first place, simply, and afterward more complexly. Not a trace of any organ is as yet perceptible, however; nor of any force, therefore, by which these organs will be governed. By the new arrangement of the particles, the molecular forces are modified anew, and this process is continuous. Although the primary forces, once united with the materials, remain the source of every action, of every manifestation of phenomena, of every chemical and organic, that is, physical, combination; they must, nevertheless, produce different effects, as the combinations become more complex. Each existing particle is the germ of a subsequent one, which is more complex; and, while the temperature necessary for hatching keeps the primary forces always excited, there is originated in the new arrangement of the particles, and also in the forces proceeding from the groups recently formed, a modification of these primary forces, which is constantly on the increase.

"The whole material of the embryo in the egg is gradually brought in this manner within the circle of action. Then the circle is still more extended, and in its action are comprehended the elements of the yolk, and also of the albumen. These are erroneously called the food of the newly-formed chicken, or its rudiments. In these elements there are forces also conjoined with the materials—chemical forces, analogous to those which exist in the embryo, and contributing to the production of the whole. These forces differ from those found in the embryo, not in nature, but only in direction, or in the mode of manifestation."—MÜLDER, *ut cit*, p. 71–73.

351. Having in the preceding sections, as well as at other times, summoned, in behalf of truth, and of the noblest institutions of nature, an adverse party, and having shown, not only by the nature of the pursuits which engage the whole practical attention of the leaders of that party, but by an open cross-examination of the acknowledged chiefs, that the entire field of physiology and medicine remains, as ever, in sole possession of those who are employed in its cultivation, and that, by no possible accident, fraud, or conspiracy, can it be transformed or transferred into the laboratory of the chemist, I shall proceed to a more critical examination of the philosophy of digestion, both in its vital, and its supposed chemical attributes.

352. All other processes of living beings, whether animal or vegetable, and especially the whole work of assimilation after the entrance of the food within the lacteals, being exclusively vital, it follows, as a great analogy of nature, that the first step in the process of assimilation is equally due to vital influences (§ 323–326).

353. Since every species of complex animals has some peculiarity of

organization, not only of the alimentary canal, but of the liver, salivary glands, pancreas, teeth, jaw, skeleton, muscles, and also of instinct, corresponding with a certain modification of the vital endowments of the gastric juice in each species of animal, which shall be exactly, and forever, and undeviatingly suited to the digestion of those kinds of food which were ordained by the Creator for the sustenance of each when He thus wonderfully instituted this almost endless system of exact Designs; each individual part having its specific final cause, each final cause modified in every species and with corresponding peculiarities of organization, and all concurring to one great final cause of subserving those exigencies of life which are fulfilled by the gastric juice, and whose modifications in different species of animals harmonize with the special attributes of all the concurring causes, and so suited by Infinite Wisdom to the nature of the food of every animal, that its *incipient* change shall be one of assimilation to the nature of the being, yet nearly coincident in all animals from the general coincidence in all organic compounds; I say, in all this labyrinth of Designs, so exactly modified in every species, yet correspondent in all, and each and all, in their individuality, their variety, their modifications, and their unity of purpose, having a specific reference to the alimentary material of each species of animal, we see in perpetual progress what is equivalent to a never-ending voice from Heaven, proclaiming that the organic stomach has no parallel in its capabilities and results in the inorganic world, or in the laboratory of the chemist. But this is not all; nor will I fail to convert the stupendous whole, as I advance with the details of assimilation, to the fundamental philosophy of organic life.

354. The constituent elements of the food having been subjected to special transformations, and imbued with the first gradations of life, by the vital action of the salivary and gastric juice, and perhaps, also, by contact with the stomach, is thus converted, in all animals, into apparently one and the same homogeneous product. It is then submitted to the farther organizing effects of the bile and pancreatic juice, passed through the wonderfully vivifying lacteals, carried forward and subjected to the whole animating influence of the pulmonary system, perfected in its exalted endowments by the whole labyrinth of the circulatory organs, and, lastly, though not least, the various compounds are determined, each and all, from *that one* homogeneous fluid, and in one everlastingly exact manner, and according to the nature of each part, by other complex living systems, and thus perpetuated forever in all their exact varieties,—but *how*, no imagination can form the most remote conception, but through the instrumentality of those specific properties of life which were the only power concerned from the beginning to the ending of the astonishing series of unvarying changes (§ 42); and, however it be that each ultimate product is destined for the immediate uses of the individual, it is undeniable that *the great final cause of every step in the assimilating process, till it results in the formation of blood, is the reproduction of gastric juice* for the maintenance of an unceasing supply to the exigencies of organic life, and the perpetuation of the species (§ 41, 323–326).

355. The gastric juice being designed to prepare the material for the formation of blood has its powers so constituted as to be merely an agent. The blood, being the *pabulum vitæ* fully prepared for the

regeneration of the gastric juice, as well as of other organic compounds (§ 354), is mostly a substance acted upon by the living solids, or by the ovum-cell, just as the food had been by the gastric juice, while it serves, also, as a stimulus to the vascular parts, and is highly endowed with the properties of life to facilitate its conversion into living solids or fluids, and to make its presence in the blood-vessels compatible with their life.—NOTE R p. 1123.

356, *a*. While we are thus employed in describing the various details of assimilation, attention is unavoidably arrested by the magnificence of its unique philosophy, and by the ultimate aim of every detail of all the immense variety (§ 353–355), even excretion itself (§ 412, &c.), at the production of gastric juice! And as we penetrate the more latent, but yet more impressive physiological laws to which that juice is obedient, we rise in admiration of the preliminary means of their fulfillment; and now again addressing myself to the chemist, I ask him as a philosopher, as one who would protect the consistency of his own science, what can be more emphatically significant of the abstraction of digestion from chemical agencies than the fact that the nervous power so modifies the vital constitution of the gastric juice that it fails of its usual function when a division is made of the pneumogastric nerve? Imagination can surmise no connection between the nervous power and the processes of chemistry. And yet do the writings of Liebig, and of other organic chemists, abound with assumptions that the supposed affinities of chemistry, as operative in animals, are subject to the nervous power! though it is conceded that the nearly coincident processes and results in plants sustain no such nervous influences (§ 500, *nn*). "*The animal organism*," says Liebig, truly, "*is a higher kind of vegetable*." To suppose that such powers operate in harmony together, and that the mind or its passions are capable of influencing, extensively, the operation of chemical forces, in constantly modifying the various secreted products, both as to quality and quantity, is a positive violation of the most obvious and universal rules in natural philosophy (§ 455 *a*, 461, 478 *b*, 488½, 493 *cc*, 893 *a*, *c*, 893½).

356, *b*. It is evident that a great difficulty exists with many, who admit a principle of life in relation to the solids, in imagining a fluid to be equally endowed, and alike capable through that principle of acting upon organic matter. But we must take the facts as we find them, nor allow inorganic nature the slightest interference. If analogies must be had, let us seek them in the organic being, and we shall be certain of success. In the instance before us we have the admitted vitality of the blood; but, unlike the gastric juice, it produces no changes in matter. We have, however, the simple ovum, "*whose vital properties*," in the language of Dr. Carpenter, "*confer upon it the means of itself assimilating, and thereby organizing and endowing with vitality the materials supplied by the inorganic world*" (§ 64, *g*). Here, then, the analogy is remarkably forcible, and the more so, as the fact is conceded by the strictly chemical school of digestion. So, of the semen, in another aspect of the active condition of the principle of life in an organic fluid; this substance, through that principle, being capable of modifying the organic constitution of the ovum in such wise, that the offspring shall inherit the intellectual, vital, and physical peculiarities of the male parent, with six fingers instead of five (§ 72, 73).

357. One of the most important arguments in favor of vital diges-

tion consists in the remarkable *endowments* of the stomach, as manifested by its vital signs, and by the sympathies which prevail between this organ and all other parts. The final cause of this peculiar constitution of the stomach, this lavish supply of the properties of life, this subservience of other organs to its dominion, must be sought in its adaptation to the generation of a fluid that may bestow the first and most difficult act of vitalization upon dead matter (§ 356, *a*). There would also have been something harsh and abrupt in nature to have admitted into the recesses of her living organization mere dead matter. It is opposed to all analogy, and is, therefore, opposed to all reason. But, that a fluid should perform this astonishing office, this first and great step in the ascending series, it must possess in a high degree the principle of life. Mysterious as it may be represented, we must all of us come at last to the admission of the existence of a vital principle; yet far less mysterious, and far less difficult of comprehension than the human soul. It is fair, then, to conclude that an organ destined for such a high function should possess that principle, in common with all other parts, as the means on which its function depends; and the best evidences in favor of this analogical inference are to be seen in its diversified manifestations of life.

358. We have seen, also, that it is conceded by philosophers who defend, *in extenso*, the chemical hypothesis of life, that there may be *something* appertaining to the stomach totally distinct from the chemical powers, and which is capable of imbuing the chyme with *vitality* and an *organic* condition; and it is, therefore, quite a philosophical conclusion that this *vital something* has an important agency in preparing the material for the admitted exercise upon it of the vivifying or organizing power. Nor can there be any valid objection to the supposition that this vitalizing power, which so far transcends the chemical forces in the organizing effect it is allowed to exert, may be fully adequate to any transmutations the food may undergo; and this inference is the more corroborated by the consideration that matter already in an organic state must be better fitted for the process of vivification than it can possibly be after its elements are broken up and recombined by forces with which those of life are in absolute opposition. Besides, the vitality of the gastric juice, or the vital influence of the stomach itself, being fully admitted, and even capable of organizing the food anew, should sufficiently protect the alimentary matter against any chemical agencies which have been supposed to operate. That this counteracting power, indeed, prevails to the full extent which I have alleged, appears to be rendered certain by the ordinary absence of any of those chemical changes which take place where numerous substances are mixed together out of the stomach—substances which often possess strong chemical affinities for each other, and whose operation within the stomach would be promoted by its high temperature. On the contrary, whatever the variety, it is uniformly resolved into one and the same homogeneous substance, utterly unlike the results of chemical reactions of one kind of food upon other kinds; and what is also as conclusive as it is astonishing, the chyle is apparently the same substance in all animals. Chemistry must here be consistent with itself, and not renounce, for the sake of hypothesis, those precise laws by which, in its legitimate pursuit, it lays open, with astonishing exactness, what had appeared the arcana

of nature. Here, too, upon the chemico-physiological hypothesis, is presented an instance in which it is necessarily assumed that the properties of life and the forces of chemistry act together in concert in converting dead into living matter—one destroying, and at the same moment the other vitalizing! while the assumption is contradicted by all that is known of the relation of these forces to each other (§ 301, 338, 360, 436).

Nor may we lose sight of the demand of philosophy not to multiply causes where one is perfectly adequate; and especially where it is admitted that all the others are of themselves wholly inadequate.

359. The last remark may be also equally applied to a common assumption which is set forth in the following apparently plausible manner: "The vitalists," says one of their opponents, "are loath to admit the operation of chemical agents at all, and would seem to consider it derogatory to suppose that any changes, save the subtle ones effected by the powers of life, are worked upon the aliment." "The *vital principle*," he says, "whatever it may be, incessantly makes use of chemical and mechanical agents for its purposes; and it is no more degrading to it to employ an acid liquid, and a triturating process, in order to digest the aliment, than it was to have recourse to bony levers, cartilaginous pulleys, and tendonous ropes."

Here, in the first place, will be observed an entire begging of the question as to digestion by an acid, since that has never been shown, and is the main point at issue. It is a perfectly unfounded and extorted inference from the factitious analogy supposed to be seen in the admitted mechanical movement of the food in the stomach, bony levers, cartilaginous pulleys, &c. But the pretended analogy, I say, is utterly inapplicable, were it admissible to reason from better premises of this nature to the existence of important facts which have no other foundation. The bony levers, muscles, tendons, heart, and large blood-vessels, are mere instruments acted upon by the vital principle, and have no part in the vital results, except as they are the passive instruments of the properties of life. The same distinction exists between the process of digestion, and the mechanical movement of the food in the stomach, or the "trituration" of the food, as it is erroneously called by the writer just quoted; since food is not triturated by the stomach excepting where that organ is designed to supply the place of teeth. There exists, I say, a total want of analogy between that mechanical movement of the food and the assumed action of an acid; since, in the latter case, a radical change is supposed to be wrought in the alimentary mass, while no such change is wrought by the mere movement, or even by the trituration or grinding of food in the stomach. The contractions of the stomach, which are purely of a vital nature, facilitate the process of digestion; but they do no more than to expose the food freely to the action of the gastric juice, by which, alone, the conversion into chyme is performed. The contractions, or "trituration," are exactly on a par, as auxiliaries to digestion, with the teeth, or with the knife, which divide the food. The *acid* alone applies to the supposed chemical process of chymification. This is the only agent, involving the only force distinct from the vital principle that is supposed to operate, and to take part with the properties of life in the functions which belong to these properties. Nor is this all. Those chemical forces, or an equivalent agent, are sup-

posed to appertain to the gastric juice (a product of the most highly endowed organ in the animal system); and through that product, and by that product, to operate independently of the vital properties, or, under their control. But, here it may be again affirmed that throughout nature there is not an analogical fact to warrant the conclusion; and with equal truth it may be said that there is nothing to aid our conception of the *co-operation* of the chemical and vital forces, while all that is known of their relations to each other proclaims their absolute independence.—*Med. Chirurg. Rev.* Lond. vol. 29, p. 107.

360. But, again, it is the admitted final cause of the gastric juice to bestow life upon dead matter, while it is incontrovertible that inorganic matter is insusceptible of any such influence from gastric action. Every fact proclaims that nature has provided the *vegetable kingdom* for the purpose, especially, of determining organic combinations out of inorganic substances for the sustenance of animal life. In the language of Liebig, "The first substance capable of affording nutriment to animals is the LAST product of the CREATIVE ENERGY"—ay, "the CREATIVE ENERGY," he says, "of vegetables."—(*Animal Chemistry.*) It is manifest, therefore, that it would be an absurdity on the part of nature to have ordained that chemical agencies should operate even at the very threshold of life, at the very fountain for which she had provided elaborate means to subvert the combinations of chemistry, and to bring them into those entirely new arrangements that approximate the changes they are destined to undergo in the animal stomach. And far less probable is it, that this fundamental principle should be lost as we ascend from vegetable to animal organization; since every chemical result within the stomach would tend to reduce the aliment to the state of that inorganic matter whose complete reduction into organic compounds was effected by the vegetable kingdom for the uses of the animal. Such chemical results, therefore, would counteract the great final cause of nature, in either organic kingdom; and, in the animal, would render the means of sustenance more and more indigestible, and progressively liable to the condition of inorganic matter (§ 338).* This is fully allowed by the chief of the school of pure chemistry, as shown in the foregoing parallel quotations. Take another summary statement, than which nothing can be more contradictory of the chemical rationale. "While no part of an organized being," says Liebig, "can serve as food to vegetables, until, by the process of putrefaction and decay, it has assumed the form of inorganic matter, *the animal organism requires*, for its support and development, *highly-organized atoms. The food of all animals, in all circumstances*, consists of parts of organisms."—(*Animal Chemistry.*) Chemical philosophy should consider that nutriment of an animal nature requires but little more than the solvent process, and the bestowment of vital properties; while, in accordance with its crude hypotheses, animal compounds must be, more than vegetable, subject to disorganizing agencies, and thus more completely removed from their original and near approximation to those of the living animal (§ 18 *a*).

361. But again I say, if the vital principle be "capable of making use of chemical agents," no reason can be assigned why it may not be equal to the whole work of digestion, and of every other process

* This argument is adopted by a writer (a distinguished chemist!) in the *Amer. Journ. of Science and Arts*, May, 1859, who *verbally* agrees with me that—"The forces of life and inorganic nature act in opposite directions, the former *upward*, the latter *downward*."—See § 301, and p. 911, § 1083. Also, p. 236, § 436.—(1860).

of living beings. The *simple* construction may be comprehended, while the other is utterly unintelligible. The former alone is agreeable to the rules of philosophy, and abolishes the inextricable confusion which attends the chemical hypothesis. What, indeed, can be meant, by the vital properties making use of chemical forces? Can there be a more glaring absurdity? more absolute nonsense? How are those chemical forces brought into use, how held in subjection, how forever maintained in one exact operation in each particular organic process, of which there are multitudes, distinct from each other, going on in the same individual? How do they elaborate from one common, homogeneous fluid, either the blood, or the sap, all the various, unique, unchanging, secreted products of the whole organic being? Products, forever the same in every part, yet differing from each other according to the nature of the part? Did you ever hear or dream of any thing analogous to this in that inorganic world where chemistry holds its empire? When do those chemical forces begin to operate, in the living body, what part do they perform, and what is the allotment of the properties of life? Is there any *known* concert of action between the two species of forces? On the contrary, is it not every where demonstrated that the properties of life are in direct opposition to the forces of chemistry?

Whatever be the construction, by uniting the two forces (as is done by the only chemical school that is entitled to a respectful notice), we convert what is a simple problem, like all other processes of nature, into the greatest paradox that has been yet devised by the ingenuity of man. It is in vain to say that some one or two of the products of organization, such as carbonic acid, and urea, are such as result from chemical affinities, since these are excrementitious; while chemistry assures us that all organic compounds are utterly different in their elementary combinations from any compound of a chemical nature.

Thus might I go on to argue this subject upon general principles alone; while at every step of the argument we should see the whole chemical hypothesis of life taking its proper rank as a dream of the imagination, or as a project of ambitious minds.

362. Digestion having been assumed to be more or less, or alto gether, a chemical affair, it rationally followed that it might be imitated by art. Accordingly, when this ambitious science had succeeded in turning the whole inorganic world into the laboratory, it set itself at the manufacture of organic compounds, and even at the entire animal. It did not, like Alexander, sit down and weep because it had no more worlds to conquer; but, like Shakspeare, having "exhausted worlds, it then imagined new." Even eminent physiologists, who should look with jealousy upon any invasions upon the laws of nature, especially upon such as it is their peculiar province to illustrate, began the manufacture of gastric juice by fire and acids, and metallic salts. We are thus presented by these philosophers with artificial compounds, of a most incongruous nature, and we are told that each one is the gastric juice; that each is capable of the same precise results as that universal product of animals, apparently the same in all, and elaborated from the blood by an organ of the highest vital endowments, and to which there is nothing analogous in all the other products of living beings, each product being, also, equally unique, and all derived from one common source (§ 135 *a*, 314, 419, 827 *b*).

363. A diversity of opinions exists as to the real nature of the chemical agent supposed to be employed by nature in the process of digestion. Free muriatic acid having been found, or supposed to exist, in the stomach, it has been concluded by many that this must be the great agent; while Dr. Prout, and others, affirm that "free muriatic acid more or less retards the process of reduction." Dr. R. Thompson, however, states that, by digesting muscular fibre in dilute muriatic acid, he produced a substance "exactly resembling chyme." This experiment was pretty widely repeated, and many were equally successful with "dilute muriatic acid" as was Dr. Thompson. Others, on the contrary, declared their failure, and others, like Dr. Prout, maintained that this acid retarded digestion. Eberle had already advanced the hypothesis that mucous membranes, no matter whether of the stomach or the bladder, dissolved either in muriatic or acetic acid, would form the true gastric juice, and perform its wonderful operations. There is now a general bias in favor of one of these compounds, though other preparations are supposed by many to form very good gastric juice. Again, it is said that the "digestive mixture," as it has been well denominated by the manufacturers, "retains its solvent properties for months," while the gastric juice loses its solvent power soon after its abstraction from the stomach (§ 341). And what equally establishes a total difference between the "mixture" and the gastric juice is the no small circumstance that the chemist may torture and extinguish the artificial "digestive principle" in a variety of ways, and then transmute it back in all its vigor. Thus, according to Schwann and Müller, the artificial "digestive principle" may be neutralized by an alkali, and afterward "precipitated from its neutral solution by *acetate of lead*, and obtained again in an active state from that precipitate by means of hydro-sulphuric acid." This precipitate, we are told, when thus treated, and thus compounded of principles radically different from the original mixture, is essentially the same as the gastric juice, and that the results of such artificial preparations must be taken as the test of the *physiology* of natural digestion; that, abandoning nature, we must look to the resources of the laboratory for any satisfactory account of her vital processes. Nor do I at all exaggerate; for it is distinctly avowed that we knew nothing of digestion till the invention of the artificial mixtures. Thus, it is said of Schwann by one so able and distinguished as Müller, that he (Schwann) "having discovered that the infusion of dry mucous membrane with dilute acid, even after it is filtered, still retains its digestive power, the digestive principle, *therefore*, is clearly in solution, and *the theory of digestion by contact falls to the ground*." Here, a most important physiological induction is wholly founded upon a process which has not the most remote connection with organized matter.

364. I have said that the experimenters took the hint of manufacturing gastric juice from the occasional discovery of an acid in the stomach. But, this is undoubtedly a rare phenomenon in a healthy stomach, and where the food has been at all appropriate in quality and quantity. The chemical hypothesis, as I have said, was long ago in vogue, and was put at rest by demonstrative proof. Distinguished observers, Hunter, Haller, Willis, Spallanzani, Fordyce, and more recently Dumas, Schultz, and others, insist that the reputed acid is the result of a true chemical decomposition of vegetable matter

Spallanzani, whose experiments were almost endless, Scopoli, Chevreuil, and others, rarely succeeded in finding it at all, and in some animals never. Spallanzani, indeed, affirms that the gastric juice is neither acid nor alkaline in its natural state.

As far back as Haller's day, when this subject was agitated, it is said by this illustrious and accurate observer, that, "although there may be some rare signs of an acid in the stomach, it does not, therefore, become us to suppose that food is animalized by a chemical process; much less to compare this process with the action of an acid." And, anticipating the modern experiments with the "digestive mixture," he declares of analogous proceedings at his own era, "frustra etiam quisquam, imitatus liquores acres chemicos, liquorem corrodentem invenerit, qui carnem in pultem resolvat." And there can be no doubt that Hunter's prophecy holds good to this day, that,

"If ever any matter is formed in any of the juices secreted in any part of a vegetable or animal body similar to what arises from fermentation, we may depend on it, it arose from that process; but we may also depend on it, that there is a defect of the living principle in these cases."

These are not the mere speculations of genius, but the facts and the conclusions of genius after a long, and wide, and experimental survey of nature. And are these observations, nay, our own experience, our own senses, to be set aside to accommodate an hypothesis of life which identifies dead, even inorganic, with living beings?

364½. But perhaps even a greater violence, than the foregoing manufacture of gastric juice, has been recently done to physiology, in the alleged conversion, by chemical manipulations, of the secreted products of organs, totally unlike, into each other. It should be conceded, however, that this has been generally sanctioned by the journals of the day. Thus, in the London Lancet for July, 1845, is a quotation from the report of MM. Villefranche and Barreswill to the French Academy on the "*Chemical Phenomena of Digestion*," from which the conclusion is deduced that

"Thus, *it appears easy to transform the gastric juice, the pancreatic fluid, and the saliva, into each other, and* TO MAKE AN ARTIFICIAL GASTRIC JUICE FROM THE PANCREATIC FLUID, and *vice versa*"!

It appears, also, from these late experiments, that the digestive principle depends on an organic matter, that "the said matter may be destroyed by an elevated temperature," and that "its digestive powers vary, according as it is associated with a fluid having an acid or an alkaline reaction."

It would seem, therefore, not improbable that a new hypothesis will soon be in vogue, and that the acid principle will be abandoned to satisfy the claims of new aspirants.

365. The assumed identity of the artificial products with the chyme of the human and other stomachs has never been shown in the slightest degree; and that it is the merest assumption is not only proved by what I have already set forth, but is fully admitted by those who advocate the chemical doctrine. The conclusion rests upon the mere appearance which the artificial substance offers to the eye. Thus, it is lately said by Dr. Davy, that

"It is impossible to witness the change which takes place in muscular fibre, in consequence of *putrefaction* giving rise to a fluid very

like chyme *in appearance*, without asking, may not PUTREFACTION be concerned in digestion itself, according to the earliest theoretical notions on the subject," and as now maintained by Liebig, and his followers (§ 350)? Farther on, however, in the same work, he says, "*twenty* different semi-fluids might be mentioned, to which, as far as the eye can judge, this putrid matter bears as close a resemblance as to *chyme*" (§ 341).

366. "Dr. Beaumont [of St. Martin celebrity] has instituted several experiments with a view to determine the power of acids in dissolving articles of food; and the results which he obtained, although they varied somewhat according to the substances employed in the experiments, have nevertheless led him to the conclusion that *no other fluid produces the same effect on food which the gastric juice does, and that* IT *is the only solvent of aliment*" (§ 341, 373).—MULLER'S *Physiology*, p. 589. *London*, 1839.

So far Dr. Beaumont's accuracy may be readily admitted. But, as his observations upon the natural process of digestion, as carried on in St. Martin's stomach, have become incorporated in most of the subsequent works on physiology, and even in systematic works on diet, where they generally serve as a foundation for some of the most important conclusions in the science of life, and have been seized upon with avidity by the supporters of the physical and chemical doctrines, and without any reference to their credibility, or to the unnatural condition of that celebrated stomach, it may be well to show, by their conflict with universal experience, that those observations are not only worthless, but pregnant with the greatest practical errors. For this purpose, it is only necessary to present a brief abstract from the tabular view supplied by the author of the average time occupied by different alimentary substances in undergoing digestion. Thus:

ARTICLES OF DIET.	*Mean Time of Chymification.*	
	Preparation.	h. m.
Pigs' feet, soused	boiled.	1 00
Tripe, do.	do.	1 00
Salmon trout, fresh	do.	1 30
Apples, sweet	raw.	1 30
Cabbage, with vinegar	raw.	2 00
Hash, meat and vegetables	warmed.	2 30
Goose	roasted.	2 30
Cake, sponge	baked.	2 30
Pig	roasted.	2 30
Pork, fat and lean, recently salted	raw or stewed.	3 00
Pork steak	broiled.	3 15
Sausage, fresh	do.	3 20
Dumpling, apple	boiled.	3 00
Green corn and beans	do.	3 45
Bread, wheat, fresh	baked.	3 30
Do. Indian corn	do.	3 15
Eggs, fresh	boiled.	3 30
Oysters, fresh	stewed	3 30
Beef, fresh, lean, rare	roasted	3 00
Mutton, fresh	do.	3 15
Fowls, domestic	do. and boiled.	4 00
Potatoes, Irish	boiled.	3 30

Here, then, we have pigs' feet nearly four times as easy of digestion as baked bread, or roasted mutton, or beef, or domestic fowls, or eggs, or oysters; raw cabbage nearly twice as easy of digestion; roasted pig and goose a third or more easier, &c. And these are

common examples of what is known, in medicine, as "the experimental philosophy of the nineteenth century," and "the march of medical science" over all former and more rational experience (§ 18).

367. The experiments with *pepsin*, or the artificial mixtures, have been limited to substances already animalized, in their simple conditions, and in minute proportions. Hay, nuts, onions, and even arrow-root, would be appalling to *pepsin;* and the quantities of the gormand, or the variety of the epicure, would soon show the nature of this branch of "experimental philosophy."

368. A chemical dilemma presents itself. The supposed chemical agent in digestion should be the same in all animals, to explain, in the least, the identity of the resulting products,—and so it is admitted by the advocates of one "mixture," or of another, respectively. But this, on the other hand, is clearly contradicted by the variety of the "mixtures," and by the vast variety of alimentary substances, consumed by different species of animals; while, indeed, if the least regard were paid to the laws of chemical affinity, it should be obvious that there would be no small variety of chemical influences in the stomach of omnivorous man.

369. Nevertheless, if the "digestive mixture" be made from the mucous tissue of the stomach of a strictly graminivorous animal, or even from its bladder, it will "digest" meat and other substances which form the peculiar food of carnivorous animals, but will refuse to digest most of the substances common to the animal from whose stomach the "digestive mixture" is prepared. This, therefore, is contrary to nature.

370. Digestion is well performed and often promoted when alkalies are taken into the stomach in sufficient quantities to hold the reputed amount of acid in a neutral state.

371. On the contrary, digestion is always impaired by the introduction of acids into the stomach while the process is going on.

372. Did the supposed acid exist in the gastric juice, it would ren der the medicinal doses of the nitrate of silver, or the acetate of lead, perfectly inert. This principle is also of obvious application to many other substances. Indeed, it would be a perpetual "incompatible" with many remedial agents.

373. If digestion depend on the supposed chemical agencies, the stomach should always undergo more or less of that change after death; especially violent death. It is the rarest phenomenon, however, in man or animals, to witness the slightest change in that organ that can be referable to the gastric juice (§ 366).

374. It is fundamental in nature that an organ which is designed for the production of an organic fluid does not also generate an inorganic substance, especially a simple element like chlorine, for the purpose of bestowing organization and life.

375. Again, since it is the mucous tissue of the stomach alone which, in all animals, secretes a juice capable of producing chyme; and as no other part of any organized being can generate a substance of similar power, how arrogant, therefore, the supposition that art can manufacture a fluid of the same virtues (§ 323–325)!

376. As new aspirants enter the field, novelties, of course, will spring up. They serve, however, to show us the importance of regarding with suspicion whatever may conflict with the long-establish-

ed conclusions which have been drawn from an observation of the most common phenomena of living beings. This leads me to advert to the experimental researches of Dr. Schultz, the eminent Berlin professor, which, whatever be their foundation, effectually destroy our confidence in all those "digestive mixtures" which have figured, of late years, so conspicuously in nearly all the systematic works on physiology.

In the first place, Professor Schultz infers that neither the stomach nor the gastric juice have much agency in digestion, but that this great office is mostly performed by the saliva. This distinguished observer also finds that,

1st. "The secretions of the stomach are always *alkaline* excepting during the process of digestion."

2d. "No food undergoes digestion without saliva."

3d. "The chyme is not produced by chemical action, but is an organic compound formed by a vital transformation of the food."

4th. "There is no such product as the supposed acid gastric juice; only a sour chyme" (§ 364, HUNTER).

5th. "The acid found in the stomach is the result of a chemical decomposition of the food" (§ 364).—SCHULTZ, *de Aliment. Concoctione*. Also, the *Rejuvenescence of Man*, &c. 1842.

Again, still more recently, M. Blondlot, under the guidance of "experimental philosophy,"* affirms that the saliva is of the nature of mucus, little else than the waste of organs (*as Liebig regards the gastric juice*, § 350), contributing nothing to digestion, and only useful as a shield to the mucous surface (BLONDLOT, *Traité de Analitique de la Digestion*, p. 124, 126).

376½. It appears, therefore, that all the prevailing physical views of digestion, the chemical doctrines of secreted products, the healthy and morbid processes of living beings, the modus operandi of morbific and remedial agents, which completely shuts out the magnificent laws of sympathy, and the whole bathos of the humoral pathology, have been, in recent times, the work of the laboratory. Physiologists and therapeutists, the British especially, appear to have forgotten that it is their business to explore the facts and the laws of organic nature, and to have turned the whole matter over to the chemist (§ 349, *d*). They have surrendered this high calling to the laboratory, and have bowed in submission to whatever its acids and crucibles have pretended to reveal as to the processes and laws of living beings. A vast number have thus discarded their lofty pursuits, and have substituted for them a most unnatural dependence upon the laboratory of the chemist.

The chemist has seized the opportunity with avidity; since his employment with inorganic nature is mostly analytical, mostly exhausted, while that which relates to living beings supplies an unbounded field for the institution of great principles and laws, whether true or false, and for the highest renown in philosophy. It is not remarkable, therefore, considering the prizes are few, the competitors many, that the "race is to the swift, and the battle to the strong," that the ambitious chemist should abandon the mere work of analysis, and push his inquiries into that magnificent department of nature where the richest laurels may be gathered. Inorganic chemistry supplies no such opportunities. Its work is analytical, and its principles few and simple;

* An artificial fistulous opening in a dog's stomach (§ 366).

and this, alone, is the legitimate object of organic chemistry. That object has been lately well expressed by Mr. Hoblyn, in his *Manual of Chemistry*. Thus:

"The peculiar principles which exist in all organized beings are distinct from those which operate on inorganic matters, and may be denominated *organic agents.* Their mode of operation is mysterious. *The object of organic chemistry is to investigate the chemical history of* the products which occur in the vegetable and animal kingdoms, and which are hence called *organic substances.*"

I therefore say, let us look well to the doings of the chemist. Let us properly regard his tampering with so profound a subject as physiology, whether in its natural or morbid aspects. Let us scrutinize his facts when he assails the experience of all the renowned in medical science through all past time, and declares that experience worthless (§ 350, *mottoes*). Let us not, however, indignantly retaliate upon him his attempts to overthrow the great fabric of medicine, or his efforts to undervalue the labors and the doctrines of men who have toiled in the field of organic nature, and have immolated themselves in the chambers of the sick. Let us rather kindly advise the chemist to cultivate modesty, and tell him, frankly, that, to comprehend the laws and the processes of living beings, they must be perpetually the objects of profound study, both in the natural state of the being and in all the variations to which he is liable from the influences of morbific and remedial agents. Let us tell him that he has acted wisely in refraining from all such observations, and in making the laboratory the exclusive theatre of his experimental inquiries. Either science, analytical, and limited in principles and laws, as chemistry may be, is enough for the compass of an individual; and medicine transcends the powers of the most gigantic mind. The physician, therefore, if he aim at the highest practical usefulness, or at the science of medicine, will find only the leisure to acquire the outlines of chemistry, and it is equally certain that the chemist who aspires at a profound knowledge of that department must spend his days and his nights within the precincts of his workshop.—NOTES DDD, GGG, p. 1149, 1151.

And now let us remember, that there is not one name in all the annals of medicine which rests for its distinction on the physical and chemical doctrines of life. On the contrary, in every instance where attempts have been made to carry the science of chemistry into physiology, in all, and every such instance, the individuals who have been so employed have sunk rapidly into oblivion; unless here and there a name, like Fourcroy's and Liebig's, which is rescued by lofty genius, and by purely chemical labors in the inorganic kingdom.

376¾, *a.* Finally, I will not forego this opportunity of bringing to the support of opinions which I have hitherto advanced the following extract from Judge STORY's late address before the Alumni of Harvard University. It will be seen that the views of this distinguished man are entirely coincident with those which I had expressed in a former work. (See *Medical and Physiological Commentaries*, vol. i., p. 331–333, 310, 307, 308, 327, 385–400; vol. ii., p. 666–677, 801–815, 12, 13, 203, 644, &c.)

"I have said," says this eminent jurist, "that the tendency in our day is to ultraism of all sorts. I am aware that this suggestion may appear to some minds of an easy good-nature, or indolent confidence.

to be over-wrought, or too highly colored. But unless we choose voluntarily to blind ourselves to what is passing before our eyes in the daily intercourse of life, it seems to me impossible not to feel that there is much which demands severe scrutiny, if not serious alarm. I meddle not here with the bold, and yet familiar speculations upon government and polity, upon the fundamental changes, and even abolition of constitutions, or upon the fluctuating innovations of ordinary legislation. These might, of themselves, furnish out exciting themes for public discussion, if this were a fit occasion to introduce them. I speak rather of the interests of letters—of the common cause of learning—of the deep and abiding principles of philosophy. Is it not painfully true that the spirit of the age has broken loose from the strong ties which have hitherto bound society together by the mutual cohesions and attractions of habits, manners, institutions, morals, and literature? It seems to me, that what is old is no longer a matter of reverence or affection. What is established, is not on that account esteemed positively correct, or even salutary or useful. What have hitherto been deemed fundamental truths in the wide range of human experience and moral reasoning, are no longer admitted as axioms, or even as starting-points, but at most are propounded only as problems, worthy of solution. They are questioned and scrutinized, and required to be submitted to jealous proofs. They have not even conceded to them the ordinary prerogative of being presumed to be true until the contrary is clearly shown. In short, there seems to me, at least, to be abroad a general skepticism—a restless spirit of innovation and change—a fretful desire to provoke discussions of all sorts, under the pretext of free inquiry, or of comprehensive liberalism. And this movement is to be found not merely among illiterate and vain pretenders, but among minds of the highest order, which are capable of giving fearful impulses to public opinion. We seem to be borne on the tide of experiment with a rash and impetuous speed, confident that there is no risk in our course, and heedless that it may make shipwreck of our best hopes, and spread desolation and ruin on every side, as well on its ebb as its flow. The main ground, therefore, for apprehension, is not from undue reverence for antiquity, so much as it is from dreamy expectations of unbounded future intellectual progress; and, above all, from our gross over-valuation and inordinate exaggeration of the peculiar advantages and excellences of our own age over all others. This last is, so to say, our besetting sin; and we worship the idol, carved by the cunning of our own hands, with a fond and parental devotion. There are many even among the educated classes, and far more among the uneducated, who imagine that we see now, as men never saw before, in extent, as well as in clearness of vision; that we reason, as men never reasoned before; that we have reached depths and made discoveries, not merely in abstract and physical science, but in the ascertainment of the moral and intellectual powers of man, and the true structure and interests of government and society, which throw into comparative insignificance the attainments of past ages. We seem to ourselves to be emerging, as it were, from the darkness of by-gone centuries, whose glow-worm lights 'show the matin to be near, and 'gin to pale their ineffectual fires,' before our advancing radiance. We are almost ready to persuade ourselves that their experience is of little value to us; that the

change of circumstances is so great, that what was wisdom once is no longer such; that it served well enough for the day, but that it ought not now to be an object of desire, or even of commendation.

"Nay, the comparison is sometimes eagerly pressed of our achievements in literature with those of former ages. Our histories are said to be more philosophical, more searching, more exact, more elaborate than theirs. Our poetry is said to surpass theirs in brilliancy, imaginativeness, tenderness, elegance, and variety, and not to be behind theirs even in sublimity, or terrific grandeur. It is more thoughtful, more natural, more suggestive, more concentrative, and more thrilling than theirs. Our philosophy is not, like theirs, harsh or crabbed, or irregular; but wrought out in harmonious and well-defined proportions. Our metaphysical systems and mental speculations are (as we flatter ourselves) to endure forever, not merely as monuments of our faith, but of truth; while the old systems must fall into ruins, or merely furnish materials to reconstruct the new—as the temples of the gods of ancient Rome serve but to trick out or ornament the modern churches of the Eternal City. Ay, and it may be so. But who will pause and gaze on the latter, when his eyes can fasten on the gigantic forms of the Coliseum, or the Pantheon, or the Column of Trajan, or the Arch of Constantine?

"May I not stop for a moment, and ask if there is not much delusion and error in this notion of our superiority over former ages; and if there be, whether it may not be fatal to our just progress in literature, as well as to the permanent interests of society? I would not ask those who entertain such opinions to accompany me back to the days of Aristotle and Cicero, whose works on the subject of government and politics alone have scarcely received any essential addition in principles or practical wisdom, down to this very hour. Who, of all the great names of the past, have possessed so profound an influence and so wide an authority for so long a period? If time be the arbiter of poetical excellence, whose fame is so secure as that of Homer and Virgil? Whose histories may hope to outlive those of Thucydides and Tacitus? But I would limit myself to a far narrower space, to the period of the two centuries which have elapsed since our ancestors emigrated to America. Survey the generations which have passed away, and let us ask ourselves what have been their literary labors and scientific attainments? What the productions of their genius and learning? What the amount which they have contributed to meliorate the condition of mankind—to lay deep and broad the foundations of Theology, and Jurisprudence, and *Medicine*—to establish and illustrate the principles of free governments and international law—and to instruct as well as amuse the leisure, and to refine the taste of social life? Unless I greatly mistake, a calm survey of this whole matter would convince every well-balanced mind, that if we may claim something for ourselves, we must yield much to the scholars of those days. We shall find that much of our own fruits have been grafted on the ancient stocks. That much of what we now admire is not destined for immortality. *That much which we deem new is but an ill-disguised plunder from the old repositories. And that much which we vaunt to be true consists of old fallacies, often refuted and forgotten,* or of unripe theories, which must perish by the wayside, or be choked by other weeds of a kindred growth.

"*The truth is, that no single generation of men can accomplish much of itself or for itself which does not essentially rest upon what has been done before.* Whatever may be the extent or variety of labors and attainments, much of them will fail to reach posterity, and much which reaches them will be felt, not as a distinct formation, but only as component ingredients of the general mass of knowledge. Many of the immortals of one age cease to be such in the next which succeeds it; and, at best, after a fitful season of renown, they quietly pass away, and sleep well in the common cemetery of the departed. What is present is apt to be dazzling and imposing, and to assume a vast importance over the distant and the obscure. The mind in its perspective becomes affected by the like laws as those of the natural vision. The shrub in the foreground overtops the oak, that has numbered its centuries. The hill under our eye looms higher than the snowy Alps, which skirt the edge of the horizon.

"But let us subject this matter to a little closer scrutiny, and see if the annals of the last two centuries alone do not sufficiently admonish us of the mutability of human fame, as well as that of human pursuits. What a vast amount of intellectual power has been expended during that period, which is now dimly seen, or entirely forgotten! The very names of many authors have perished, and the titles of their works are to be gathered only from the dusty pages of some obscure catalogue. What reason can we have to suppose that much of our own labors will not share a kindred fate? But, turning to another and brighter part of the picture, where the mellowing hand of time has touched with its finest tints the varying figures. Who are there to be seen but Shakspeare, and Milton, and Bacon, and Locke, and Newton, and Cudworth, and Taylor, and Barrow, not to speak of a host of others, whose works ought to be profoundly studied, and should illustrate every library. *I put it to ourselves to say, who are the men of this generation to be brought into comparison with these, in the extent and variety of their labors, the powers of their genius, or the depth of their researches?* Who of ourselves can hope to exercise an influence over the human mind as wide-spread as theirs? Who can hope to do more for science, for philosophy, for literature, for theology, than they? I put the argument to our modesty, whether we can dispense with the products of their genius, and wisdom, and learning; or may cast aside their works, as mere play-things for idlers, or curiosities for collectors of the antique?

"I have but glanced at this subject. It would occupy a large discourse to unfold it in its various bearings and consequences. But the strong tendency of our times to disregard the lessons and the authority of the past must have any thing but a salutary effect upon all the complicated interests of literary as well as social life. It not only loosens and disjoints those institutions, which seem indispensable to our common happiness and security, but it puts afloat all those principles, which constitute, as it were, the very axioms of all sound philosophy and literature. In no country on earth is the danger of such a tendency so pregnant with fearful results, as in our own; for it nurses a spirit of innovation, and experiment, and oscillation, which leaves no resting-place for sober meditation or permanent progress. It was the striking remark of an acute observer of the human mind, that 'he who sets out with doubting, will find life finished, before he

becomes master of the rudiments;' and that he who begins by presuming on his own sense has ended his studies as soon as he has commenced them."—*Judge* STORY's *Address*, &c.*

376¾, *b*. In parting, for the present, with organic chemistry . would again pay my humble tribute to a science of exalted worth, in its vocation of laying open the constitution and laws of inorganic nature, and in applying its results to many of the most useful purposes of life. The physiologist venerates the science, does homage to its cultivators, would do battle for its cause. In protecting the great Institution which it is his province to illustrate, in preserving unsullied the stupendous philosophy of Medicine, he makes no encroachment on a sister science; but, ever obedient to the voice of Nature, he worships in all her temples (§ 1034).

4. DISTRIBUTION.

377. The fourth function common to animals and plants is distribution or circulation. In the former, after the food has become so far assimilated as to receive the final act of appropriation, or, in other words, after it is formed into blood, it must be distributed to all parts of the body, for their growth, nutrition, &c. This office is performed by the heart and blood-vessels in all perfect and superior animals, and by the blood-vessels alone in the inferior tribes, and whenever the heart is wanting. In the last instance the means are very similar to those which carry on the circulation in plants.

378. The mechanism of circulation is shown by the function. In the perfect animals the blood is expelled by the left ventricle of the heart into the aorta, and thence distributed to all parts of the body; where it is applied to nutrition and secretion, and undergoes depuration by the excretory organs. Such as is not thus appropriated is sent forward to the communicating veins, by which it is conveyed to the right auricle, and from thence to the right ventricle, to be distributed to the lungs through the pulmonary artery, and returned, again, to the left ventricle through the pulmonary veins and left auricle. In the lungs, the venous blood is converted to arterial, and perfected for the various exigencies of organic life, by the joint agency of the pulmonary mucous tissue and atmospheric air (§ 419, 827 *b*).

379. A remarkable exception occurs to the foregoing general plan of the circulation in the transmission of venous blood from the abdominal viscera to the liver, through the vena portæ. It is also anomalous, that this blood is appropriated, in part, to the formation of an organic fluid, the bile, while the residue is transmitted to the vena cava through the hepatic veins; these veins being also the associate medium for the return of blood from the hepatic artery (§1031).

380. There are three principal distinctions between the blood sent out by the left ventricle and that which is returned to the right: 1st. The color of venous blood is a modena red; that of arterial a bright scarlet. 2d. Venous blood is more highly charged with carbonaceous matter than the arterial. 3d. Venous blood will not support the life of organs.

381. The blood supplies all parts with their means of nutrition, secretion, &c., and is, itself, the stimulus by which its own circulatory organs are excited to motion, and by which the formative and secretory vessels are maintained in their action. The *pabulum vitæ* is,

* See a remarkable parallel to the foregoing in TACITUS' *Dialogue concerning Oratory*. The coincidences should admonish us the more.

therefore, remarkably distinguished from all other substances in nature, in being equally the stimulus of the whole circulatory system, and the substance acted upon and appropriated according to the nature of every part in which it may circulate (§ 136).

It is the same with the sap of plants as with the blood; both being alike the *pabulum vitæ*. Each is every where converted into the solid organs to which it is distributed, and into fluids and other products which have their special allotment in organic life; and nothing is formed which is not derived immediately from the blood or sap (§ 41–44, 847 *c*, 1053).

OF THE POWERS WHICH CIRCULATE THE BLOOD.*

382. Much of the philosophy of medicine is involved in a right estimate of the powers which carry on the circulation of the blood. But, having set forth this subject extensively in the Medical and Physiological Commentaries, I shall now limit my remarks to a statement of the most prominent facts (§ 407, *a*).

383, *a*. A great error has prevailed of ascribing the circulation of the blood to the propelling power of the heart alone. Another, less common, imputes venous circulation to the action of the capillary arteries; while a still greater regards it as a hydrostatic phenomenon dependent on the arterial column of blood. Another, subversive of all principles in medicine, refers the circulation in the capillary vessels—those instruments of all the essential organic processes—to capillary attraction. Another supposes that the blood is moved in virtue of its own inherent power. Another, that the globular portion is composed of animalcula, which traverse the circulatory system by their locomotive endowment. But, the most obnoxious to objection is the latest speculation which flows from the universal doctrine of Liebig, that

"All vital activity arises from the mutual action of the oxygen of the atmosphere and the elements of the food;" that "the life of animals exhibits itself in the continual absorption of the oxygen of the air, and its combination with certain component parts of the animal body;" and that "the cause of the state of motion is to be found in a series of changes which the food undergoes in the organism; those changes being the results of processes of decomposition, to which the food itself, or the structures formed from it, or parts of organs, are subjected." (See § 350, nos. 9, 10, § 1054).

This last hypothesis imputes the circulation entirely to the chemical action of oxygen gas upon the tissues and upon the blood itself; rejects, altogether, the propelling and suction power of the heart, overlooks the respiratory movements, the peristaltic action of the intestinal canal, the permanent contraction of the sphincters, the motions of the iris, denies all vascular action, even in the face of such phenomena as blushing, and all other sympathetic movements, nor recognizes a local morbid physiological determination of blood, or a morbid process, or a physiological influence of therapeutical agents, but construes all these unique results upon the same chemical phenomenon.

383, *b*. A modification, however, of this doctrine concedes an instrumentality of the heart in circulating the blood. The heart still acts in virtue of the combustive process; and so far the doctrine is

* The term *powers*, as here employed, comprehends the instruments of circulation.

consistent. But it is fundamentally contradicted by the incongruity of the two great sources of power at the apex and at the circumference of the circulation, when contrasted with the exact balance which prevails between the moving power of the heart and the circulation of the blood in the capillary system. Nor is there to be found in nature two such distinct sources of power for the accomplishment of a specific effect as that which imputes the circulation of the blood to an associate mechanical impulse by the heart and a chemical process in the capillary blood-vessels (§ 129).

384. There are numerous elements concerned in the circulation of the blood, each one of which I have endeavored to substantiate in a former work.*—See also p. 934, § 1090.

1st. The heart possesses, through its vital properties, an active power of dilating and contracting (§ 498, *e*, 1090),

2d. The arteries possess a similar power, though in a far inferior degree. This has been determined by the application of irritants.—(*Medical and Physiological Comm.*, vol. ii., p. 147–152, 375–403.)

3d. The capillary arteries, or the reservoirs of blood to the extreme vessels, have the same power, which is much more actively exercised than in the larger arteries. The capillaries are consequently brought into greater action when stimulated by physical agents, as in inflammatory diseases, or by the nervous power, as in blushing (§ 480, 1039), or as it lights up inflammation (§ 647½, 746 *c*, 973–974).

4th. The extreme vessels, or terminating series of the arterial system, have, also, a like power of contracting and dilating actively, and in a still greater degree than the capillary arteries (§ 136, 750).

5th. The extreme capillary veins have, also, a special action of the foregoing nature, which aids in transmitting the blood from the arterial system to the next larger series of veins.

6th. The larger veins possess the power of dilating and contracting actively, according to the varying quantities of blood transmitted from the arterial system. Their constant *conatus* to contract on their contents assists in the transmission of the blood.

7th. All the cavities of the heart operate upon the principle of an exhausting pump, during their dilatation.—Note Bb p. 1131.

385. All the foregoing powers (§ 384) concur together, according to a consummate Design, in circulating the blood. All are important elements; no one adequate in itself, while each should be studied by itself, as well as in connection with the whole (§ 74, 80, 117, 137, 143, 155, 156, 169 *f*, 266, 303¼ *a*, 306, 310, 311, 387, 399, 409 *f*, 422, 514 *h*, 524 *d*, 525, 526 *d*, 528, 638, 733 *b*, 750, 764 *b*, 811, 847 *c*, 848, 902 *f*, 905, 1054). The Exp. &c. are in the Commentaries.*

386. The contraction and dilatation of the heart and arteries are, respectively, nearly synchronous. Although there be a perfect consent of action between the capillaries, the extreme vessels, and the heart, those vessels are not associated with the movements of the heart, nor with each other, in the same way as the actions of the heart and arteries; and they are modified, also, according to the special functions they perform in different parts (133 *b*, 135 *a*, 136). The case of blushing shows us the law in regard to the capillaries (§ 476, &c.).

387. The final cause of motion in the veins is chiefly that of sub-

* Medical and Physiological Commentaries, vol. ii., p. 375–426, 147–152, and the Essay on the *Theories of Inflammation, ibid.*

serving the arterial system; and here the consent of action between the veins and arteries is still more illustrative of the profound nature of the principles and laws which govern the functions of organic life. It has been, indeed, the universal doctrine that the capacity of the veins is determined in a mechanical manner by the volume of blood transmitted from the arteries; but I have endeavored to show that the supposed physical distension and elastic contraction of the veins are without foundation, and would form a most serious obstacle to the circulation of the blood. On the contrary, it appears that those actions are not only of a vital nature, but that they are a perpetual illustration of sympathy, depending upon sympathetic relations of the veins to the communicating series of arterial capillaries.

This peculiar constitution of the veins explains the reason why they collapse when divided; since their sympathetic relation to the arteries is thus extinguished. The veins, indeed, appear to be not less susceptible of action from the stimulus of sympathy with the capillary arteries than the iris with the retina (§ 514, *k*), whose phenomena so clearly demonstrate the operation of that principle in developing sensible motions; but compounded as to veins of continuous and remote.*

The dilatations and contractions of the veins are, therefore, very greatly effected by reflex nervous influences exerted upon them by the varying states of the capillary arteries, as well as by the quantities of blood they are employed in transmitting to the veins. These influences appear to be originally felt by the capillary series of veins, where the organic properties are most strongly pronounced, and thence propagated by continuous sympathy to the larger series (§ 498, and *Comm.*, vol. ii., p. 520, 521, &c.), when reflex actions ensue.*

Did not a consent of action with the arteries (depending on the principle of sympathy, § 452, 495, &c., 498) exist in the veins, the vital contractility, and the elastic property of the coats, must be mechanically overcome by the increased quantity of blood transmitted to them. The blood must be forcibly injected into the capillary veins by the *vis a tergo*, and in numerous parts of difficult penetration by the finest injections of art. This is utterly repugnant to that Unity of Design which prevails in all parts of the organized being, and would be leaving an important function to a fortuitous and inadequate provision. Nor can it be consistently supposed that the phenomena which appertain to one class of vessels are of a vital nature, and those of the other, resulting in an anatomically associated series, mechanical.

The veins possess, also, longitudinal fibres, by which they are fitted for rapid and uniform motion over an extensive tract; and this action implies a predominance of continuous sympathy (§ 498). It is also proved that the veins, like the heart and arteries, dilate actively on the application of certain stimuli to their external surface.—(*Med. and Physiolog. Comm.*, vol. ii., p. 147–152, 375–401.)

388. Venous circulation is determined principally by the suction or derivative power of the right cavities of the heart, but is aided by the contractile power of the large veins, by the more specific action of the capillary veins, and by the propelling power of the communicating series of arterial capillaries. The contraction of the left ventricle of the heart, and that of the large arteries, have little or no agency in venous circulation. Their force is probably exhausted, or

* Continuous sympathy is *continuous influence* of these Institutes (sec. 129 *c*, *f*, 498 *a*)

nearly so, when the blood has reached the terminal series of the arterial system.

The blood is returned from the lungs to the left cavities of the heart by the powers just stated.

It is not alone the dilatation of the auricles which constitutes the derivative power, as had been supposed till I investigated this subject; but equally, also, that of the ventricles (§ 1090).

389. In the Medical and Physiological Commentaries, I have examined every objection which has been alleged against the imputed dependence of venous circulation upon the dilatation of the cavities of the heart, and atmospheric pressure. One objection had been stated with greater force and apparent plausibility than the rest, by Drs. Philip, Arnott, and other eminent men; namely, that the parietes of the veins should collapse upon the supposed doctrine of suction. To this objection I have replied, that the injecting power of the communicating arterial capillaries maintains the veins in a state of fullness. The perfectly harmonious relation among the powers which circulate the blood establishes a correspondence between the movements in the venous and arterial systems, by which nature has duly provided against so great an evil as apprehended.

390, *a*. The suction power of the heart, as I have endeavored to show in the "Commentaries," is indispensable to the portal circulation, and to that, also, of the lymphatics, lacteals, thoracic duct, and umbilical vein; though, doubtless, the independent action of these vessels contributes to the motion of their contents.

390, *b*. In the foregoing work I have considered the objection relative to the occasional jet of blood from a vein wounded in venesection in certain conditions of disease; and I purpose now, from its ambiguous relation to my subject, adverting to the causes of the intermitting pulse that so often attends congested states of the liver. This phenomenon has been long observed; but no substantial cause has been assigned. It is due, I apprehend, to two influences, one of which is sympathetic, the other more or less mechanical.

The sympathetic is readily appreciated; the mechanical, and most important, requires explanation. In my Essay on Inflammation, and in the present work, I have endeavored to show that the current of blood is accelerated in the vessels immediately concerned in that morbid process, notwithstanding the enlarged diameters of the vessels (§ 711, &c.). But not so in venous congestion, unless the propelling, and therefore, also, the suction power of the heart, be considerably increased. It often happens, however, that the force of the heart, in venous congestions of the liver, is even reduced below its ordinary standard, however there may be an attendant hardness of the pulse (§ 688). Now, therefore, since the veins undergo an enlargement in their congested states, and since, also, the volume of blood which is transmitted to the heart through the portal system is very large, if it enter that organ in an unusual manner, it is highly probable that it would embarrass its action. Such would be the effect of a sluggish or irregular ingress, especially, as will be seen, if not correspondent with the egress of blood.

But, it not unfrequently happens that the pulse becomes intermittent, for the first time, after the hepatic affection has sensibly yielded. This occurs, however, mostly, if not altogether, in rather intense

forms of venous congestion, and where the force of the heart, and therefore its suction power, are manifestly increased, so much so, indeed, that practitioners, cautious of blood-letting, will venture upon the remedy. An incomplete subsidence of the disease, and the means of treatment, reduce the action of the heart; and the suction power being thus lessened, while the veins remain yet enlarged, the blood moves with a tardy pace in the portal veins, and disturbs the rhythmic action of the heart.

There is also another, and important element of this mechanical cause, which consists in an interrupted balance between the blood which enters the heart and that which is projected from it; its entrance being rendered slow by the state of the portal veins, while its projection is unembarrassed. If the pulse be merely intermittent, and only so after several beats, excitement from exercise, but not from the mind, will often restore, for a short time, the harmony of both ventricles. Mental excitement, on the contrary, through nervous influence, is apt to increase the intermission, and often adds an *irregularity* (§ 227, 509, &c.). But, unlike the simply intermitting, an *irregular* pulse is commonly increased in its irregularity by violent exercise, as well as by excitements of mind. The intermitting pulse, on the contrary, is often most strongly pronounced in the horizontal posture. Reflex nervous influences enact a part in this phenomenon.

The nature of the *sympathetic* cause will be readily appreciated by the accurate observer, when he considers how often intermissions or irregularities of the pulse are increased by a full, and sometimes a scanty meal (§ 512), through reflex nervous actions.

Cerebral inflammation often gives rise to an irregular action of the heart; but here the cause is determined by the nervous power alone (§ 226, &c.). In the case of the brain, also, the pulse is apt to be more irregular than intermittent; while in that of the liver it may be both (§ 687, &c.).

391. The valves of the veins have been universally supposed to contribute essentially to venous circulation, by supporting the column of blood. This, however, I have endeavored to show, is a mistaken opinion;* for they are always open when the current of blood is passing. Like the valves of the heart their great final cause is to prevent the reflux of blood when pressure operates, and to contribute to the like design of the frequent inosculation of the veins. The supposed co-operation of the voluntary muscles in venous circulation is also merely accidental.

392, *a*. It appears, therefore, that the whole theory of the circulation is strictly relative to the properties of life. The pressure of the atmosphere, by which the blood is forced along the returning vessels, is entirely incidental; and, although the transit of blood from one part to another is merely mechanical, its motion originates entirely in vital agencies. The facts, of which the foregoing conclusions are predicated, are very numerous, and contribute to some of the most important pathological and therapeutical principles. It may be useful to consider yet farther some of the most indisputable, and to regard them, at the same time, in their connection with the laws of which they are the foundation.

392, *b*. Although the vascular system contributes an important part

* Medical and Physiological Commentaries, vol. ii., p. 412, 426.

toward the common circulation, the heart possesses within itself a general control over this great function of life. Had it been otherwise, "a thousand causes might intervene, over which the organ, so limited in influence, could have no control, to retard or divert the course of the blood; and which, by occasioning one short delay, might prevent its return forever." It is, therefore, not only the great motive source, through its contractile power, in the universal act of distribution, but, to effect a return of the venous blood, "it is made the centre of atmospheric pressure and gravity, and designates the stage in the circulation in which a deficiency of supply would be the last in being felt. Hence it appears that the functions of the heart are performed, and life preserved, notwithstanding long and copious discharges of blood, which, upon any other hypothesis, must have been fatal. For, according to these hypotheses, the heart, or at least the auricles, are placed at the end of projection. They mark the highest advance of the tide, and would first be abandoned by the retiring fluid. They would be drained by every profuse hemorrhage, and the heart would expend its energy in fruitless efforts to circulate a fluid that came not within its reach." Upon any other theory, how could what Armstrong calls "the beautiful balance between the right and left sides of the heart" be preserved? How, otherwise, would the circulation be restored in syncope? In respect, also, to the absorbent power, it is farther well said by Carson, that, "though we are not acquainted with any data from which the power of the heart can be calculated, there must exist, nevertheless, certain limits, within which it must reasonably be supposed to be confined. If we consider that the quantity of blood in circulation is nearly one fifth of the weight of the whole body; that this great mass is spread over an immense surface; that it is therefore subjected to great resistance from friction, especially in the small vessels where each globule is to be rolled over a fixed surface; that the currents, in consequence of anastomosing branches, are perpetually flowing in opposite directions, and that attraction must powerfully prevail between the blood and small vessels; when we consider the mass moved, the motion with which it is moved, and the resistance opposed, it is impossible to imagine that this labor could have been performed by the propelling power of the ventricle;" besides the obvious objections of the liability of the curvature of the aorta and the capillary arteries to be ruptured, and the exigencies of the portal, placental, and lymphatic circulation (§ 390).

Again, "the two trunks of the ascending and descending cava meet at the heart in such a manner as to form a straight line. The streams of blood which are conveyed by these vessels to the heart are placed at that point in direct opposition. Upon the supposition that the blood is returned to the heart by a *vis a tergo*, this position of the vessels is the most unfavorable that can be conceived for the office that is assigned to them. The momentum of blood in one vessel would be destroyed by that of the other; or, if the current in the descending was stronger than that in the ascending cava, the blood in the weaker stream would be prevented from ever reaching the heart."

392, *c.* In the Medical and Physiological Commentaries, especially in the Essays on Inflammation, and the Powers which Circulate the Blood, I have exhibited a great amount of proof establishing the vital actions of the capillary blood-vessels, and showing that the mo

mentum of the blood, as derived from the left cardiac ventricle, is nearly lost in the capillaries. The opinion of Hunter, Bichat, Philip, and other distinguished observers, to the same effect, being founded upon the most ample investigations, would seem to leave no doubt upon a question of such fundamental importance in the philosophy of organic life. "Have they," says Wilson Philip, "who maintain that the circulation is supported by the muscular power of the heart alone, made even the rudest calculation of the degree of resistance to be overcome in driving the blood through two capillary systems at such a rate, that, in a given time, the same quantity shall be delivered by the veins, which is thrown into the arteries? Have they made any estimate of the strength necessary in the different sets of vessels, and particularly in the larger arteries, to sustain a power capable of overcoming this resistance? Let them give what imaginable power they will, they cannot make this power greater than the coats of the vessels will bear without rupture" (§ 1054, 1056).

So completely arrested, indeed, is the momentum of blood when it reaches the arterial capillaries, so manifest are the vital actions of these vessels, and so unaccountably did Philip and Bichat overlook the suction power of the heart, that they ascribed the circulation in the veins entirely to the propelling action of the capillary arteries. Owing to this limited view, Bichat was led to observe, that, "notwithstanding all that has been written as to the cause of venous circulation, there is an obscurity in it, in which there are but few rays of light." The circulation of the liver embarrassed him especially; since any general hypothesis which should fail here must be wholly abandoned (§ 390). He considered it, however, "incontestibly proved, that when the blood has arrived in the general capillary system, it is absolutely beyond the influence of the heart, and that the left ventricle has no influence in the venous system."

392, *d.* The demonstrations of a direct nature, to show the independent action of the blood-vessels (the veins as well as arteries), are too numerous and various for concentrated observation. They are scattered throughout this work, and many of importance occur only in the *Medical and Physiological Commentaries* (vol. ii., p. 147–152, 375–401). The original suggestions of many belong to myself, as, also, their general application to the subjects before me. It has been one of my special objects to demonstrate an active dilatation of all the blood-vessels, as well as their active contraction. The latter, indeed, proves that the dilatation is active and vital. The greater principle lies in the necessity of a counteracting power; since active contraction alternating with dilatation necessarily implies corresponding principles of motion, or there would be a permanent state of contraction or tonic spasm. The sanguiferous system, therefore, would be devoid of function, and nothing but "stagnation" would be the great law of organic nature (§ 748, 1039, 1090).

393. The doctrine of venous circulation, as I have expounded it here, and proved it extensively in the "Commentaries," is replete with the most important physiological, pathological, and therapeutical conclusions. It strikes a fatal blow at the whole mechanical hypothesis and the stimulant treatment of venous congestion (§ 788–793), as shown in my Essay on that affection. It determines all the great fundamental points which have been in dispute respecting the circu-

lation of the blood. It proves that the propelling force of the left ventricle of the heart is lost, or nearly so, in the extreme capillary arteries. It proves, what is of greater importance than all things else in the Institutes of medicine, that the extreme vessels possess an independent vital action; since otherwise the blood could never be carried forward in the veins by the power of suction (§ 389). But that would not be the greatest oversight in the plan of organic nature (§ 1039, 1040).

394. The highest practical, as well as philosophical, conclusions are involved in a correct estimate of the powers which determine the circulation of the blood (§ 393). But there are no errors so prolific of evil, and so derogatory to medical philosophy, as that which assumes a passive state of the terminal series of the arteries, or that circulation is carried on in that series by capillary attraction, or by their oxydation (§ 383).

Were either of these hypotheses true, there could be none of the organic products, as derived from the blood, no secretion, no nutrition—not a principle in physiology, pathology, or therapeutics; for all the essential organic functions, and all the processes of disease, are carried on by the terminal series of the arteries (§ 481 *g*, 483, &c.).

Consider the phenomena of sympathy; contemplate the experiments of Philip to determine the laws of the vital functions; study the laws of the nervous power in their relation to organic functions; observe how instantly mental emotions will variously affect the action of the heart, or bring a suffusion of blood to the pallid face, or how stimuli applied to the brain will as instantly produce corresponding results (§ 481–485); and you will concede that these results of the operation of the nervous power demonstrate the independent vital action of the capillary vessels, and overturn the physical and chemical hypotheses of life.

395. The foregoing influence of the cerebro-spinal and ganglionic systems upon the capillaries and extreme vessels is of the highest importance in pathology, and in the philosophy and treatment of disease. These vessels are not only the instruments of disease, but they sustain all the morbific influences which result in sympathetic diseases, and upon these vessels all remedial agents exert their curative effects, whether by their direct action, or through the instrumentality of the nervous power (§ 222–233$\frac{3}{4}$, 456 *a*, 1039, Note Bb p. 1131).

396. Nor is it alone an active condition by which the terminal series of arteries is remarkably distinguished. Our various facts establish the no less important principles, that the several orders of terminal vessels have their vital properties and actions strongly pronounced, and that these properties and actions are peculiarly modified in their natural state, both in a general sense, and in different parts, and that they are liable to various other peculiar modifications from the operation of morbific and therapeutical agents. Hence, all our curative means must have a steady and direct reference to the existing condition of these extreme capillary vessels (§ 149, 150, &c.).

397. Of the extreme vessels physiologists have supposed, with great reason, that there are at least three series; one being destined for nutrition, another for the secretion and excretion of the fluids, and another series coinciding with the veins.

Without being disposed to submit this question, in the least, to the

microscope (§ 131), there might be allowed, according to Wagner, what has probably been hypothetically suggested by the well-known simplicity of nature, that there is "but one kind of termination in reference to an artery—a passage into a vein through a capillary vessel, and an intermediate net-work." In this case, however, there must either exist lateral projections from the terminal capillary, or there must radiate from the "intermediate net-work" vessels whose office is to distribute the blood from which are eliminated the materials for nutrition, &c.

398. The extreme vessels which are destined for nutrition, secretion, and excretion, elect from the blood, contained in their reservoirs the capillary arteries, the precise elements that are necessary to the formation of each peculiar compound throughout the body, and in such uniform proportions and modes of combination as shall forever, and without deviation, render them exactly conformable to the nature of every part, as ordained at the CREATION (§ 41–44). This is done in virtue of the peculiarly modified states of irritability and other properties of life, according to the exact office of every part. Yet are these the vessels which are said to be under the sole government of physical and chemical laws (§ 383), and whose morbid state in inflammation is constituted by a mechanical relaxation of their parietes, and a stagnation and coagulation of their contents (§ 711, &c.)!

399. In their natural state, the foregoing vessels admit but very few of the red globules of blood, in virtue of their peculiarly modified irritability; and this, therefore, where the calibre surpasses the diameters of the red globules. There is no mechanical "*straining off* of the finer from the coarser parts of the blood" by an inadequate capacity of those vessels which convey only white blood (§ 493, *d*). The separation is effected in a homogeneous substance, and by causes which are very foreign to "strainers" and "sieves" (§ 129, 135–138, 266, 750). The same principle interprets the admission of the red globules into those serous vessels, in inflammation. Irritability is there morbidly affected, and the usual process of vital decomposition of the blood is, of course, arrested (§ 327–329). The entire blood then finds its way into the lymph vessels, as they are called; and the organic law by which that result is determined (§ 192, 278) is beautifully illustrated by two experiments; one by Buniva, the other by Procter The experiments also confirm the doctrines which I have taught as to the character of the nervous power, and its agency in organic actions, while both observers pursuing different routes, and attaining a common end through opposite effects, but by common principles relative to the nervous power, illustrate and confirm the experiments of each (§ 222–233¾, 476, &c., 500).

Buniva had great difficulty in effecting an injection of an artery of a living dog, till he divided the spinal cord, when, by thus withdrawing the stimulus of the nervous power, the capillaries lost their peculiar susceptibility, and the contents of the syringe passed freely on.—BUNIVA (§ 1039, 1056).

In Procter's experiment, "a horse was killed by dividing the medulla, the bowels turned aside, and the branch of the sympathetic nerve, which joins the ischiadic, laid bare; also, one of the arteries of the leg. A wire applied to the positive pole of a galvanic battery, defended with sponge, was applied to the nerve, and the nega

tive wire to the artery. The positive wire was then drawn slowly along the plates of a fifty-plate battery and the effect was certainly not only to reproduce the pulsation in the artery, but also clearly to excite circulation in the more minute vessels." A by-stander exclaimed, "See how that pipe beats when they put on those wires!" —Procter, *on the Sympathetic Nerve.* 1844.

To the foregoing may be added the experiment by Dr. Hall (§ 263), which, it will have been observed, is insuperably opposed to his conclusions as to the agency of the nervous system in producing organic actions, and as examined in my Essays on "Vitality," &c. (p. 42, *note*). See, also, Experiments by Kriemer, § 485, and Philip, § 483, and Dr. Parry's case, § 487, *gg*.—Note Q p. 1122.

5. APPROPRIATION, OR NUTRITION AND SECRETION.

400. Appropriation, like assimilation, is a comprehensive, though less complex, function. It embraces what are commonly designated as two functions, namely, nutrition and secretion.

401, *a*. A common fluid being formed, and distributed to the several parts of the animal and vegetable, is then appropriated to their several uses.

401, *b*. Animals are distinguished by an unceasing change of the materials of which they are composed. The actions of life disturb the composition of parts, which, being thus unsuited for the purposes of organization, and reduced to a fluid state, are returned to the general circulating mass of blood, where they either again undergo assimilation, or are eliminated and cast off by the excretory organs. To supply this waste is, in part, the office of appropriation, which furnishes new molecules from the blood, in exact conformity with the process of disintegration after growth is completed, but occurring in excess while nutrition is engaged in rearing up the fabric to a state of maturity. Appropriation is also the function through which those secreted fluids, which act as auxiliaries in the processes of life, are renewed in their original character.

402. Appropriation, therefore, whether it refer to the increase and renewal of the solid parts, or to the production of useful fluids, being equally a process of secretion, every organic product, vegetable or animal, is the result of secretion. But appropriation, as applied to the useful fluids that are formed from the blood or sap, is more commonly known as an act of secretion; and though the next function which will be considered, namely, *excretion*, is very analogous, yet the final causes of secretion and excretion being entirely different, it is proper that they should be arranged as distinct processes.

Since, however, nutrition, secretion, and excretion are very analogous processes, *secretion* is a good generic term for the whole. Each process consists of certain acts by which new formations are generated from the blood. All parts are first eliminated in a fluid state. Such as are destined for nutrition assume the condition of the solids which they supply as soon as eliminated: such as subserve the uses of fluids remain permanently fluid. It is evident, therefore, that appropriation, in a philosophical sense, is the highest act of assimilation, but may be very properly regarded as a function by itself.

403. Every part of the body possesses a secreting apparatus, since every part appropriates the blood to itself (§ 398).

404. The organs which generate the permanent fluid products are very various, and more complex than such as carry on nutrition. The former are either glands or simple membranes, acting in their compound condition (§ 92). The immediate instruments consist of a simple series of extreme vessels which pervade every part, and which are every where so constituted, anatomically and vitally, that they elaborate from the common nutritive fluid such compounds as are exactly conformable to the nature of each part respectively (§ 41–44, 133, &c., 135 *b*, 188, &c., 205, &c., 233, 397, 398).

405. The variety of secreted products, solid and fluid, is greater, and the quantity more abundant in animals than in plants, and in proportion, also, to the complexity of organization.

406. The following products of secretion which remain more or less fluid occur in the animal kingdom. The first six are common to most animals:

1. Gastric juice.
2. Saliva.
3. Pancreatic juice.
4. Bile.

} Concerned in digestion.

5. Serous fluids.
   - Of the serous tissues.
   - " cellular tissue.
   - " articular tissues.
   - " chambers of the eye.
   - " capsule of the lens.
   - " labyrinth of the ear.

6. Mucous fluids.
   - Of the mucous tissue of the mouth.
   - " " " nose.
   - " " " pharynx.
   - " " " larynx and trachea.
   - " " " lungs.
   - " " " stomach.
   - " " " intestines.
   - " urinary and genital organs.
   - " skin of aquatic animals.

7. Tears.

8. Fatty or oily liquids.
   - Suet, and fat of cellular tissue.
   - Marrow of bones.
   - Liquids in the cryptæ of the skin.
   - Cerumen of the ear.
   - Fatty fluid of prepuce.
   - Many other oily products.

9. Fluids of defense.
   - Ink of the sepia.
   - Liquids of insects.
   - Virus of serpents, &c.
   - Galvanism of torpedo, &c.

10. Humors of the spider, and of other insects, from which their webs, cocoons, &c., are formed.

11. Fluids necessary to the preservation of the species.
   - Germinal fluid.
   - Semen.
   - Product of vesiculæ seminales.
   - Liquor of Cowper's glands.
   - Liquids in the fœtal membranes.
   - The milk of mammifera.

The foregoing fluids are variable according to the nature of the animal, but always the same in each species, and analogous, respectively, in all (§ 53, &c., 83).

407, *a.* In considering the mechanism and the function of appropriation, it devolves upon the Institutes of Medicine, as in all other anatomical and physiological inquiries, to apply the whole to the elucidation of the laws upon which the mechanism is founded, and under which the phenomena take place. It will still be my purpose, therefore, to interrogate the whole in their various relations, and to illustrate the philosophy of the whole by contrasting the defects of spurious systems.

407, *b.* The exact anatomical condition of the instruments of nutrition and secretion, as well as the functions themselves, can never be brought within the cognizance of sense; nor would it be of any practical use to know them beyond what is revealed by the vital and physical results (§ 83, 131). By these facts we are enabled to institute many of the most important conclusions in physiology. By them, especially, we demonstrate the errors of the physical and chemical doctrines of capillary circulation, and of the chemical and mechanical hypotheses relative to secretion. By them, we show that all the products from the blood, as well as effusions of blood in the ordinary forms of capillary hemorrhage, find their way out of the vessels through some vital act, and that the physical doctrines of percolation, and endosmose and exosmose, have no foundation in organic nature (§ 131, 275).

407, *c.* It has been also seen by demonstrations in respect to the development of the ovum, that appropriation is conducted by the same powers throughout the life of the being that were brought into action by the stimulus of semen; and it may be now added that the coincidence is beautifully enforced by a progressive and uninterrupted march of that primary development, which was instituted in the ovum, after the beginning of independent life (§ 63–81, 153–159).

408. The mechanical doctrine of filtration, which supposes the incalculable variety of secreted products to exist already formed in the blood (§ 41), still disfigures the physiology of the schools, and forms a prominent characteristic in the prevailing pathology of inflammation. To the whole of this subject, as well as to the chemical hypotheses, I have given an extensive investigation in my Essays on the Humoral Pathology, on the Vital Powers, on the Theories of Inflammation, on Endosmose and Exosmose, and on Diabetes, as embraced in the Medical and Physiological Commentaries. Many remarkable assumptions, intended to sustain the physical rationale of vital processes, are there examined and refuted. But, the explosion of one error, it has been said, often prepares the way for another; as exemplified in the following quotation relative to the hypothesis of endosmose and exosmose:

"This permeability to gases," says Liebig, "is a mechanical property, common to all animal tissues; and *it is found in the same degree in the living as in the dead tissue.*"—Liebig's *Animal Chemistry.*—See, also, § 350, 1031 *b.*

409, *a.* When considering the subject of proteine in a former section (§ 18), I reserved for this place all that was not immediately relative to elementary composition. What was there set forth should be

applied in connection with what I shall now advance in continuation of the subject.

409, *b*. We have seen that, in opposition to the received doctrines as quoted from Liebig in section 18, there is nothing in the secreted products of animals, solid or fluid, that subsist on vegetable substances similar to the food, except in elementary composition, nor in the blood itself; while it is also affirmed by Liebig, that "*analogy, that fertile source of error, has unfortunately led to the* VERY UNAPT COMPARISON of the *vital functions of plants with those of animals.*" But the reader, who may have attended to the parallel columns, and the sections on the chemical hypotheses of disease and therapeutics, will be neither surprised at the inconsistencies now and formerly indicated as to the prerogative of the vegetable kingdom in doing the whole work of assimilation, and even trespassing upon that of appropriation, in behalf of the animal tribes, nor unprepared for a farther explosion of the doctrine by its principal author. Let us, therefore, hear the chemist yet farther in his contradiction of the great fundamental doctrine (§ 18). Thus:

"We must not forget," says Liebig, "that, in whatever light we may view the vital operations, the production of nervous matter from the blood presupposes a change in the composition and qualities of the constituents of blood. That such change occurs is as certain as that the existence of the nervous matter cannot be denied. In this sense, we must *assume* that from a compound of *proteine* may be formed a *first, second, third,* &c., *product, before* a certain number of its elements can become constituents of the nervous matter."

Again, having in view another special point, we are told that

"This much, at least, is undeniable, that the herbs and roots consumed by the cow contain no butter; that in hay, or the other fodder of oxen, no beef suet exists; that no hog's lard can be found in the potato refuse given to swine; and that the food of geese or fowls contains no goose fat or capon fat;"—"that as yet no trace of starch or sugar has been detected in arterial blood, not even in animals which had been fed exclusively with those substances."—(See *Comm.*, vol. i., p. 674–682.)

And what gives special plausibility to these speculations is the controversy which has taken place between "the Reformer" on one side, and Dumas and other French chemists, on the other, respecting the origin of *fat;* the former maintaining that it results from transformations of sugar, starch, and other "vegetable proximates," while the latter contend that not only this, but agree with Liebig that all the other unique products of herbivorous animals are formed without the aid of their complex assimilating organs,—that they are merely applied as generated by the plant. In this latter doctrine is also seen a striking display of the human mind to run into simple views of nature; overlooking all the complicated facts and the whole labyrinth of animal organization, and making the ultimate sustenance of animal life but one remove from the constituents of the atmosphere (§ 303¼, 304, 305, 322).

And again, when chemical demonstrations cannot be resisted,

"We *must admit*," says Liebig, "as the *most important* result of the *study* of the composition of gelatinous tissue, and as a point *undeniably established*, that, although formed from compounds of *proteine*

it *no longer belongs* to the series of the compounds of *proteine*. *No substance* ANALOGOUS to the tissues yielding gelatin is found in vegetables."

Nay, not even in the blood itself; though,

"It is *conceivable* that membranes and tissues which yield gelatin are formed from albumen by the addition of oxygen, of the elements of water, and those of ammonia, accompanied by a separation of sulphur and phosphorus. *At all events, their composition is* ENTIRELY DIFFERENT *from that of the chief constituents of the blood.*" "But there is no doubt that these tissues are formed from the constituents of the blood"! Q. E. D.—LIEBIG'S *Animal Chemistry*.

It will be thus seen that the chemist is finally coerced to the admission that many of the most important organic compounds depend altogether upon the specific action of organs by which they are elaborated from the blood, and that he is even embarrassed with a "doubt" whether "these tissues are formed from the constituents of the blood." The admission is comprehensive. It betrays the factitious nature of the whole physical rationale. It proclaims that every secreted product is different from the common source of supply, and different in every part of the animal. Chyme differs from chyle, and blood from either. Each differs in every species of animal, from man down to the white-blooded tribes; yet each, wherever existing, is forever the same in the same species. And so with plants, even with such as seek for ammonia and nitrates upon the dung-hill, or others that gather iodine from the deep (§ 289, 350, nos. 26½, 77). Each product, therefore, is generated in its unique characteristics by agents and processes which are designed specifically for the formation of each. Nor would this be doubtful to any observer who may pass along the various gradations of the assimilating organs from their simple condition in plants to that complexity which demanded the superaddition of the nervous systems (§ 336, 356 *a*, 461, 478 *b*, 488½, 493 *cc*, 500 *nn*, 893 *a*, *c*, 893½).

If we take, now, the premises on which the chemist proceeds to the exact conclusions which he sets forth in his formulæ of organic compounds, those who have been inattentive to his method will be surprised at its destitution of all but vague conjecture, where organic compounds are concerned; and, for the unique nature of these compounds the reader must turn to what I have said on the subject of *Composition*. The following is the great starting point:

"The organs are formed from the blood, and contain the elements of the blood. They become transformed into new compounds with the addition only of oxygen and water. Hence the relative proportion of carbon and nitrogen must be the same as in the blood.

"If, then, we subtract from the composition of blood the elements of the urine, then the remainder, deducting the oxygen and water which have been added, must give the composition of the bile.

"Or, if from the elements of the blood we subtract the elements of the bile, the remainder must give the composition of urate of ammonia, or of urea and carbonic acid"! Q. E. D.—LIEBIG'S *Animal Chemistry*.—See LEHMANN'S opinion p. 780, § 1029, 1031 *b*.

Such, once more, is the basis of organic chemistry, with all the apparent precision of mathematics in its extraction of a cube root; yet never the same in its analysis of the *elementary* composition of the blood, avowing the homogeneous nature of that compound of 17 or

18 elements, and, finally, in the very midst of its mathematical accuracy, allowing that there is no one organic compound elaborated from the blood by the *living* similar to the results of *artificial* processes. This I have already abundantly shown, even in the present section, and in another relative to it (§ 18). The same evidence abounds in the parallel quotations (§ 350), and a glance at the "*Animal Chemistry*," or the "*Organic*," would supply other facts for my present purpose. Thus, in the following sentences enough is conceded to substantiate my position; and it is worth the specific remark that "we know with certainty" that albumen and fibrin have not the same composition.

"We must be careful not to deceive ourselves in our expectations of what chemical analysis can do. We know, with *certainty*, that the numbers representing the relative proportions of the organic elements are the same in *albumen* and *fibrin*, and hence we conclude that they have the same composition."

"If we reflect, that from the *albumen* and *fibrin* of the body all the other tissues are derived, it is *perfectly clear* that this can only occur in *two* ways. Either certain elements have been *added to*, or *removed from*, their constituent parts," and so on.—LIEBIG'S *Animal Chemistry*.—NOTE N p. 1121.

409, *c*. If the viper be fed exclusively with any one substance, its peculiar poison will be generated; and so of the characteristic products of the civet, the cuttlefish, the skunk, the beaver, &c.; each, also, being always generated by one particular part. Here, then, are tests for an important and comprehensive philosophy. From these we may descend along a scale, where we shall find in some of the secreted products of every animal and plant certain prominent characteristics which declare that not only these, but the less striking, also, are as much dependent on special organization, and special powers and actions, as the poison of the viper, or the fœtor of the skunk, or the civet, or the beaver, or the ink of the cuttlefish, &c. Will any thing in nature, excepting the mucous tissue of the stomach, produce a substance at all analogous to the gastric juice? Is there any thing analogous to semen in the blood? Can it be generated by any thing but the testis (§ 83, *b*)? Can it be surmised that it is at all the product of forces which govern the inanimate world? Consider the nature of granulations, so obvious to the eye, and yet so analogous to the products of nutrition. From whatever parts of the body they spring up, they have all, originally, the same appearance. The same in bone as in muscle. But, so various are the modifications of their vital constitution, that they ultimately elaborate substances exactly conformable to the nature of the tissues, respectively, by which the granulations were generated. We know that there must be specific powers to effect these results, and that in each tissue, and in the granulations thereof, the powers are modified; and we know, also, that the results defy all explanation by any chemical or mechanical laws.

409, *d*. Carry the same principle to morbid conditions. Is not the virus of hydrophobia generated exclusively by the salivary glands, and by those glands in a particular state of disease, and probably, also, by the canine and feline tribes alone? Does not every morbid product require a specific mode of disease? Is not this distinctly exemplified in scarlatina, measles, small-pox; and, therefore, equally true

in less striking cases? Equally as true of common pus as of the pus of variola? And here I would refer to what I have said, in my Essay on Inflammation, of the nature and formation of pus;* how its formation is indiscriminately imputed by the same philosophers to a spontaneous alteration of blood in the large vessels, to chemical actions in the small, and to the decomposition of dead animal matter; how its analysis has led different chemists to opposite conclusions both as to its nature and formation; and how it is affirmed by the chemist to be unchangeably the same, whether the product of an abscess, of a chancre, or of the variolous pustule. The confusion in these respects is very remarkable, showing the perfect inadequacy of the principles by which the explanation is attempted; while they, who believe that animated nature operates by other forces, see nothing but admirable simplicity, and a fountain of the highest practical advantages to mankind (§ 653).

409, *e.* Again, do we not find remarkable relations between the structure of secreting organs and the matter secreted (§ 346)? Where organization is most complex, the secretions are most compounded, and, as the structure becomes more and more simple, so also do the corresponding secretions. And yet, in the most simple membranes, apparently of the same organization, the products, according to Cuvier and others, are almost as various as the different species of animals, consisting of fluids in some, and of air in others; yet always the same in each species. On the other hand, what complexity of organization in the liver of the higher animals; yet all is precise, harmonious, and adapted to specific ends. Those ends, and that complexity, are fatal to all the chemical and physical views of the functions of assimilation and appropriation. And yet is the secretion of bile, which, according to the chemists, is composed of forty different compounds, and these made up of four or five elements, compared to what is supposed to be a chemical evolution of carbon from the blood; and the liver is also said, by distinguished physiologists, to be merely a "strainer of bile." We are told that "physiologists have been induced to suppose that the structure of the kidney is such that it allows the urea to percolate through the fine vessels emptying into its pelvis, like the mechanical operation of *sifting* or *filtering*, but denies a passage to the other constituents of the arterial blood." But how "deny" them; why do they never escape; why do not the constituents of the bile come this way, and *vice versa?* Is it more difficult for one substance to "sift and filter" its "passage" through one set of vessels than the other? The iatro-mechanical, it is true, are comparatively few with the iatro-chemical philosophers. The latter have also greater zeal. They are more recently in a field full of seductive novelties, and other allurements, while pure chemistry can offer nothing but the details of analysis (§ 1032).

409, *f.* All the secreted fluids not only have an apparatus peculiar to each, whose complexity corresponds remarkably with the compound nature of their products, but they are all destined for important specific ends in the economy of living bodies; a final purpose of which chemistry and physics are wholly incapable. One would be perfectly unsuited to the office of another, and would be even destructive of life, in most of the cases, should one product interchange with

* In *Medical and Physiological Commentaries*, vol. ii., p. 181–204.

another (§ 129, 135–137). The saliva, gastric and pancreatic juices are designed for digestion; the blood being thus an almost direct cause of its own reproduction (§ 323–325, 356 *a*). The bile subserves three specific purposes, which, when regarded in their connection, supply one of the most remarkable instances of Design. This fluid participates directly in the assimilation of food, is the important cause of peristaltic motion, and performs, lastly, that inferior office, which is often regarded as its only one, of contributing with the lungs, kidneys, and skin, as an emulgent of the blood, though in a different aspect from the organs of excretion (§ 415, 423). The products of the serous membranes are designed, for the most part, to facilitate organic and voluntary movements; mucus serves, like the cuticle, to protect its organ against offending causes, &c.; the "humors" of the eye, and of the internal ear, are media of communication between external objects and the nerves of sensation; and they are wonderfully adapted to the laws which they are intended to subserve. The semen, milk, fat, animal heat, &c., are other remarkable examples of final causes which secretion is intended to fulfill. To these might be added many others, less important, but not less to our purpose; as the poison of snakes and of insects, the galvanism of aquatic animals, the ink of the sepia, the fluid from which the spider builds his house, and with which we cure intermittent fever, &c. And, when we regard, in connection, the bile, the gastric juice, semen, milk, &c.—all derived from the homogeneous blood,—and consider the uniformity of their respective composition in health, their changes according to the alterations of the vital properties in disease, and these changes corresponding with certain modifications of the vital phenomena, are we not moved with astonishment at the total difference in their nature? Is there any relief for our astonishment but in a firm reliance upon powers that are equally unique in their operation? Would not amazement otherwise increase, till it should prove that the human mind does not rightly interpret the laws of nature, and is unjust to its own endowments?

409, *g*. If we now survey the vegetable kingdom, we shall find all things constituted upon the same plan. The poppy, digitalis, croton, spurge,—every thing growing side by side in the same earth, the same air, and watered with the same fluid, have, each one, its unique and unvarying sap and secreted products; an infinite variety of precise combinations derived from about four simple elements (§ 41, 42). Again, also, not only different species of plants when flourishing in the same soil yield different products throughout, but the same species have produced, from the day of their creation, the same identical products, in all their parts, in every variety of soil and climate. And so of all animals, whatever the variety of food. In the vegetable kingdom, we are also amazed at the systematic Design manifested in the coincidences between the various elementary combinations and their virtues as vital stimuli, or as morbific or remedial agents, which obtain among numerous species of many genera of plants, and which are maintained in all the varieties of soil to which the plants may be subjected. But, while these analogies prevail among the medicinal properties of certain extensive groups of plants, the products of each species, and of the several parts of the same species, have certain peculiarities, and these, too, will depend, in many plants, upon the stage of their advancement toward the flowering season, while they are not influenced by soil, climate, &c. (§ 52, 155).

409, *h*. Apply what has now been said of the products from the sap of plants to the formation of blood alone, which is composed of about the same elements, and we see how vain the attempts to explain by chemical laws even the formation of chyle; its conversion even from a white to a deep red color, and yet that color changing to white again under the influence of slight disease; and, finally, the vitality with which the blood is endowed. And, notwithstanding the complexity of the human body, its endless variety of food, and its artificial combinations and changes, has not the chemist given us a standard of the composition of the chyle, the blood, the gastric juice, bile, saliva, milk, &c., by which their morbid changes are to be tested in all countries, at all seasons, at all ages of man and of the world? Has he not told us that all this is so uniform in the natural state of the animal, so unlike the results of chemical agencies, that when changes arise they are indicative of changes in health? And does he not offer to show, that this alteration of the blood and secretions is so uniform under the same circumstances of disordered health, that you may tell by it the nature of disease and the appropriate remedy (§ 5, 5½ *a*)? Is not this the basis of practical humoralism? I grant the fact as to the relation of specific changes in the secretions, the blood, also, and specific modifications of action. But is not all this in absolute opposition to whatever is known of the capricious operation of chemical forces? And what shadow of proof is there, that these vital powers, which the chemist now and then invokes to his aid, are not entirely adequate to the physiological results that are ascribed to the forces of chemistry?

409, *hh*. As to the hypothesis which supposes that galvanism is identical with the nervous influence, and the efficient power in the formation of animal products, it is fully contradicted by the many analogous compounds generated by plants. This subject will have been variously considered in other places (§ 70–80, 409 *k*, 493 *cc*, 893 *a*, &c.).

409, *i*. And now, turning again to the mere physical theorist, if there be any who cannot appreciate the objections which I have set forth to their peculiar views of secretion, let them appeal to their ordinary habits of observation, and look at the condition of the blood as reputedly laden with the various compounds which are supposed to be strained off from the great vital fluid. What an unphilosophical mixture! All the forty ingredients of the bile into which that homogeneous substance is separated by the various manipulations of the chemist,—all the variety into which the urine is resolved by the same ingenious devices,—mucus, saliva, gastric juice, albumen, gelatin, cerebral substance, fat, tears, sweat, milk, semen, the germinal fluid, &c.,—nay, more, all the peculiar compounds which go to the formation of the different parts of the body; and each one, and no other, strained off by that part alone which has been forever engaged in the individual office of eliminating one exact compound, or one special variety of compounds. Nor is this the end of the absurdities; for the same physical doctrine supposes that this principle is coextensive with the vegetable kingdom, and that every species of plant and animal embraces in its circulating fluid special varieties, which, in the aggregate, make up the many millions of specific and unvarying compounds of which the organic kingdoms are composed (§ 41). Nor is it a small part of the difficulties which surround the mechanical and chemical hypotheses of secretion, that all these millions of compounds

are liable to exact variations, according to morbid changes in the parts by which they are elaborated.

409, *j*. Is the chemical hypothesis of *catalysis* better calculated than the mechanical to resolve the great problem which concerns the formation of the millions of unique products from one common fluid, and in conformity with the facts which have been hitherto stated? This doctrine is, doubtless, the most ingenious of any which has been advanced by chemistry; but it has little to sustain it even of the specious analogies supplied by inorganic processes. Indeed, so little is *catalysis* supported by the phenomena of inorganic nature, that its existence is denied by many able chemists. Thus:

"Liebig," says Mülder, "has been led to reject *catalysis* entirely, and to give a totally different explanation of facts. He has *assumed*, that chemical forces are in action in those substances which, according to the supposition of Berzelius, are capable of exciting action, though without taking part in that action; and he thinks that by such chemical action, another may be excited in other substances. He adopts the principle, indicated by La Place and Berthollet, that a molecule, being put in motion, can communicate its motion to others, if in contact with them. He applies this principle to yeast especially," &c.—MULDER'S *Chemistry of Vegetable and Animal Physiology.*

In section 350¾, *d*, is a brief statement of the catalytic theory as advocated by Mülder; and in the Medical and Physiological Commentaries (vol. i., p. 55–78) I have considered specifically the obstacles to its application to organic processes, while it must encounter, also, all that I have here alleged against the mechanical and other physical doctrines. Nor is it the least objection to the whole chemical system of organic life, that the two principal leaders in organic chemistry "*give a totally different explanation of facts*," that make up the essential attributes of living beings. Mülder affirms that Liebig's theory is an "assumption," while Liebig "*rejects entirely*" the catalytic theory of Mülder. The medical reader will easily appreciate the worth of Liebig's "assumption," by referring to its attempted "explanation of facts" as revealed by disease. (See § 350, *nos.* 40, 41, 42, 44, 45, 350¼, and LEHMANN on *Chemical Equations*, § 1029).

409, *k*. In respect to the supposed agency of galvanism in the formation of animal compounds through the medium of the nervous system, the doctrine is consistently applied to the modifications which arise from morbid processes; but we have just seen (§ 409 *hh*) that the fundamental hypothesis is contradicted by the close analogy between the products of plants and animals, and by the absence of the nervous system in the former, and therefore, *a fortiori*, galvanism has no connection with morbid products. Galvanism is also alike a stimulus to the secretory functions of plants and animals, which farther establishes its distinction from the nervous power (§ 113, 224, 226, 356 *a*, 399, 446 *a*, 461, 475½, 493 *cc*, 500 *nn*, 512, 893 *a*, *c*, 893½, 902).—NOTE Y.

410. We may therefore well conclude that there is nothing so important in the whole compass of physiology, and in the philosophy and practice of medicine, as a proper understanding of the vital constitution, in their properties and functions, of those extreme vessels by which nutrition and secretion are performed. Those are also the instruments of all morbid processes, and those by which all morbid products are elaborated from the blood. And since all healthy products are clearly the result of processes to which there is nothing anal-

ogous in the world of dead matter, how obviously must all the products of disease, all those of inflammatory conditions, which vary but little from the natural standard, be owing to the same vital processes of those formative and secretory vessels somewhat diverted from their natural states, and in which deviations disease must be allowed to consist (§ 750, 1039, 1040, 1056).

411. Finally, the function of appropriation is that which evinces, more than any other, the existence of a vital principle. This principle, being admitted as the basis of that function, must be carried to every other process of living beings. It is by appropriation that the new elementary combinations, in their endless variety, are formed from the blood or sap. By nutrition, which begins at the earliest development of the embryo in the aspect of growth, under the government of a peculiar power, as admitted by all, the organic being is carried forward to full maturity, and maintained while life continues. At every stage of his existence, it is the same process as that which was started by the impression of the semen upon the germ; and, since no new results are brought forth, no new powers can be called into operation. The living semen is the first stimulus of the organic properties of the embryo, and in this respect it is analogous to those vital stimuli which forever after maintain the same powers in action, and by which the same nutrition, or the same elementary combinations, are effected at every subsequent stage of existence. By nutrition, through the operation of these vital properties, and according to specific plans instituted by the Creator, and to be forever perpetuated by the substituted energy of the vital principle, all those forms of organic beings, which pass by almost insensible gradations from the mushroom up to the gigantic tree, and from the microscopic animalcule to the majesty of man, are maintained in all their exact peculiarities, in all their analogies to each other, in all their vital and moral attributes. It is by nutrition, that is to say, by the specific modes in which some three or four principal elements are united together, and joined to pre-existing parts of the same nature (§ 41, 42), that each animal or plant, according to its species, acquires and maintains a specific configuration and organization, exhibiting vital results that are peculiar to each, producing specific germs that are developed in exact conformity with the nature of the parent, and each pursuing forever a certain path which was marked out for itself alone by the Hand which gave it existence. Such, and far more, is the *wonderful power*, a power substituted for the *Creator Himself*, which directs capillary circulation, and governs the process of nutrition in the development of the embryo, in the maturity of the being, and in the perpetuation of the species.

Briefly, then, the whole essential philosophy of organic life, all that is important, or useful, or dignified in medicine, is directly relative to the vital constitution, and the vital actions of the formative and secretory vessels. *Here is the labyrinth of life, here of disease, here the ultimate aim of medical philosophy* (§ 1040).—NOTE I p. 1118.

6. EXCRETION.

412. Excretion is the sixth grand function common to animals and vegetables. It is analogous to secretion, and is performed by analogous organization; though the differences in these respects are probably greater than between nutrition and secretion, in their ordinary acceptation (§ 402 404).

413. By excretion useless matter is elaborated from the blood and ejected from the body. The results of this function, therefore, are entirely different from those of secretion, which are destined for useful purposes in the animal economy.

414. The terminal series of the arterial system, as with appropriation, are the immediate instruments of the function of excretion. But, like secretion, a compounded organization is necessary to excretion. In this respect there appears to be about the same anatomical variety allotted to secretion and excretion (§ 404). The same tissue, indeed, and even the same part, may perform both functions; as in the lungs, and in the uterus (§ 135).

Notwithstanding, however, these coincidences, the final causes of excretion and secretion are so very different (§ 413), the processes which give rise to such opposite results should be regarded as different functions.

415. The difference between secretion and excretion, as denoted by their respective uses, is confirmed by the elementary constitution of the products of these functions; those of secretion being organic, those of excretion inorganic. There is also reason to believe that special elementary changes take place in the urine soon after its elimination from the blood.* Urea may be also artificially produced; and such is not improbably the fact when chemically obtained from blood, or even from the urine (§ 53, *b*, 1032 *a*, LEHMANN).

416. The principal excreted substances are, 1st. *Carbon;* 2d. *Sweat;* 3d. *Urine.* The lungs, skin, and kidneys, are the organs by which they are elaborated. The lungs and skin exercise their function, principally, after nutrition and secretion have been performed, and are, therefore, mainly concerned in excreting the waste parts of the body; though this devolves also upon the kidneys, especially in disease.

417, *a*. No one of the foregoing products is of an organic nature; and the supposed triumph of the chemist in manufacturing urea is no more a proof of the dependence of organic compounds on chemical processes than any other transformation.† The sweat and the urine being liable to transformations as soon as elaborated (§ 415), and more especially as every chemical agent by which their analysis is attempted necessarily changes their composition, their actual condition at the moment of their production can never be known. Such, also, is true of the analysis of every organic compound. The very analysis supposes the generation of compounds or of elements in artificial modes; but the original compound being the product of the organic powers, the transformation of its elements, whether spontaneous or effected by the chemist, and through certain agencies, occurs in certain determinate modes, and according to the influences which had been impressed by the organs of life (§ 54, *a*). Besides, it is now fully admitted that many very uniform and remarkable formations out of organic compounds, and themselves, too, allied to organic substances, have no such natural existence; as hydrocyanic acid, narcotin, &c. (§ 42, 409). Even Magendie threw in the way of proximate analyses the conclusive fact that, "during the short transit from the vascular tubes to your receiver, the component elements of the blood are found to effect a new arrangement" (§ 1032 *b*, *c*).

* See *Medical and Physiological Commentaries*, vol. i., p. 526, 585, 602, 675–679.

† LEHMANN says that—"We can hardly *any longer* enumerate urea among true organic substances."—1850.

417, *b*. When, therefore, I may speak of changes in the "component parts" of organic compounds, I refer either to such as may be wrought by organic processes, or by influences exerted by less obvious causes, as in the case of the bile (§ 316), or to those chemical transformations of a specific nature which depend upon chemical agencies (*a*).

418. Carbon is the greatest excrement of animals, and is evolved from plants. In the former it is effected by the mucous tissue of the lungs, and often by the skin (§ 135); in the latter by the leaves (§ 303¼).

419, *a*. The excretion of carbon by the lungs is construed by the chemists according to their rules of interpreting other organic actions. But, as I have endeavored, in the "Commentaries," to establish the vital character of this phenomenon, I shall only now advert to its philosophy, and in connection with that which respects the production of animal and vegetable heat (§ 433, &c.). They are thus associated by myself out of regard to the confusion which has befallen them in the hands of the chemist. But, appealing to him who sees in organic nature its plainest contradistinctions from inorganic, I would, in this place, submit to his understanding whether it be not probable that the same philosophy attends the elaboration of carbon by the lungs and by the skin, and whether that function of the skin in many animals be not as much an organic process as the associate secretion of sweat?

419, *b*. But, if the foregoing analogies be not sufficiently conclusive, consider, next, the elaboration of that excrementitious matter, the urine; which all but the purely physical philosopher recognize as a vital process. And, again, shall it be admitted that, while nature has constituted the pulmonary mucous tissue, like that of the stomach, intestine, bladder, &c., upon her universal plan of organization, and endowed it with the vital function of generating mucus, she has departed from it in an isolated part of one and the same continuous tissue to introduce, along with the vital, a chemical function? It is the same argument as derived from the production of sweat, in its connection with carbonaceous matter; and here the analogy brings into cooperation every product of the living being, and establishes the whole upon common principles (§ 447½ *c*, 1032 *b*).

419, *c*. There remains, however, a demonstration from analogy which is perfectly irresistible. We have already seen how differently modified in their vital character are not only different tissues, and tissues of the same apparent organization, but even different parts of one and the same continuous tissue. We have seen this exemplified in a variety of aspects, and especially by the specific nature of the product of certain parts. We have seen, for example, that there is nothing in nature but that part of the gastro-intestinal mucous tissue which lines the stomach that will generate gastric juice, while, also, it produces mucus (§ 133–136). Now, carry this to another part of the same continuous tissue which lines the air-cells, and the inference is plain that if the gastric juice be elaborated by a vital process, so also is the carbonaceous matter. Nor can any objection be urged that other parts of the mucous system do not contribute to the function of decarbonization upon the ground that they are less delicate, and therefore less permeable to the air, than the mucous portion of the lungs, since, in some animals, that dense organ, the skin, performs the same office. Nor is there a better chance for the application of en

dosmose and exosmose, since atmospheric air is often in contact with the mucous tissue of the stomach (§ 447½ *c*).

420. Perspiration or sweat, which is sensible and insensible, being elaborated by an organ of highly complex organization, is clearly a product of organic actions; and since the skin of some inferior animals, like the mucous tissue of the lungs, eliminates both mucus and carbon, this coincidence of function in two very complex organs may be considered worthy of some regard in forming the logical induction to which the facts in the preceding section may seem entitled.

421. The excretion of urine is the next great source of depuration to the blood. Like the other products of excretion, it contributes to the process of assimilation by its depurating effects (§ 416). It is astonishing, too, with what rapidity many substances appear in the urine after their admission into the stomach; often not more than five or ten minutes intervening. This rapidity of excretion is particularly true of all matter which is offensive to the organization.

422, *a*. There is a remarkable sympathy subsisting between the kidneys and skin, by which, as it were, they interchange functions with each other. We are all familiar with the fact that the urine is most abundant in cold weather, and the perspirable matter most deficient, and *vice versa;* and, as a general principle, when one excretion abounds, the other is lessened. This is true in disease as in health (§ 129, 1032 *a*). It depends upon reflex nervous actions.

422, *b*. For the fulfillment of their final cause the kidneys possess an exquisite susceptibility to the influence of the nervous power (§ 188, &c., 226, 528). Hence arises the rapid and profuse excretion of urine when fear and certain other emotions of the mind are in operation. The same affirmation, too, may be made of the skin, though perhaps less extensively. This, too, is the reason why fear so readily induces copious sweats. In either case, the phenomena are owing to the direct development and determination of the nervous power upon the organs, respectively. These phenomena, too, prove the great susceptibility of the skin and kidneys to the influence of the nervous power, and are a key to the whole philosophy of the interchanges of action between the skin and kidneys (§ 129, 230, 638½).

But there are, also, as may be inferred from the facts just stated, great sympathetic relations between the skin and kidneys and many other organs, though these relations are much more manifested by effects which arise sympathetically in the excretory organs than by the influences of these organs upon other parts. This is mostly seen in disease, and during the operation of remedial agents applied to the stomach. So great, indeed, is the susceptibility of the skin and the kidneys, in their excretory function, to remedial agents, that a large variety have received the denomination of sudorifics, and another class, diuretics. But, owing to the special vital constitution of the skin and kidneys, by which they are rendered sensitive in their excretory function to a thousand slight influences, it is obvious that the foregoing denominations of remedies convey hypotheses that are unfounded, and of injurious tendencies. There are no better sudorifics than fear and hot water; no better diuretic than impending danger (§ 246, 500, 892¾, 1040); all through *direct* or *reflex* nervous influence.

422, *c*. In respect to the foregoing principle as shown by diseased conditions the facts are not less familiar. In such cases, an organ

which is naturally designed for secretion may sometimes, by a morbid increase of its products, take on the relative function of excretion, and thus, both by morbific reflex nervous actions, and by copious elaborations from the blood, diminish or suspend the excretion of urine. In the cholera asphyxia this excretion would fail entirely, even when the profuse intestinal discharges were unattended by the usual perspiration. But, in the case of the intestinal affection, much was due to the morbific, vital influences; since we often see the urine increased by the active operation of cathartics.* Scarcely a morbid state disturbs the organs of digestion without diminishing or increasing the effete products of the kidneys and skin, especially of the former organ. The kidneys, however, being designed for the mere purpose of depuration, do not hold a corresponding sway over the great organs of life, but mainly so as it respects their dependence upon those organs (§ 129); while a greater reciprocity of sympathy between the skin and the essential viscera of life, and a predominant sympathy between the skin and kidneys as organs of excretion, evince the wonderful nature of Design in its provisions and limitations, according to the final causes which directed the plan of organic life (§ 325).—Illustrated by heart in § 500 *m*, 687½–688, 694¾, 826 *cc*.

423. How vain the attempt to refer any of the foregoing processes and results to any of the forces or laws which rule in the inorganic world! The entire rationale rests upon the peculiar operations of the nervous power, and its laws of reflex action (§ 222, &c., 446, &c., 455 *e*, 500). A balance of actions and products is thus perpetually maintained, though, of course, with less uniformity and exactness in sickness than in health. But nature, ever provident, has so constituted the properties of life, that when one organ, whether excretory or secretory, becomes morbidly suspended in its function, the evil will be felt by other organs, by reflected nervous action; and they will thus take on, as it were, the work of that suspended organ. If the excretion of urine be wholly arrested, not only the skin, but many other parts, may join in the concerted action of relief. But, no other part will ever excrete urine, no more than the skin will secrete semen.† The absurdity of this prevailing doctrine is shown, at once, by the fact that urine would excoriate the eliminating vessels of every part excepting those of the kidney (§ 83 *b*, 133, &c.).

Organs of pure secretion, however, may take on, in consequence of the foregoing condition, the office of excretion; that is to say, they will elaborate, along with their natural fluids, the excrementitious matters, in certain *peculiar* combinations, which, in the healthy state of the kidneys, would appear in the form of urine (§ 417).

424. The philosophy of all that I have now said in respect to the interchange of offices among the organs of secretion and excretion, and of the dependence of the several products upon special conditions of anatomical structure and modifications of the organic properties, is the same that is concerned in the process of lactation after parturition, however different the remote and final causes. The mammary glands sympathize with the new change in the uterine system, and produce a fluid which is totally different from the blood, although, like all other products, it is derived from that fluid. And, there

* See my work on the *Cholera Asphyxia* of New York, 1832.
† See *Medical and Physiological Commentaries*, vol. i., p. 526, 588, 603, 608, 680.

would be just as much wisdom in supposing that the reflex nervous action of the womb upon the mammary glands, at this critical juncture, is a chemical phenomenon, as there is in referring the elaboration of milk to the capricious forces of chemistry, while its reputed filtration from the blood, by others, is equally refuted by the sympathetic nature of lactation in every species of mammifera (§ 1031, *b*).

425. The excretion of urine, more than the products of any other part, may be affected by the absorption of unnatural agents into the circulation. This is because many agents which will excite the action of the kidneys are not offensive to the lacteals nor to the system at large, and are therefore freely absorbed. Such are many saline and alkaline substances, and others, again, which are natural to the body, as aqueous fluids, &c. Those being either unnatural or redundant rouse the action of the kidneys, as the proper organs for their elaboration. The quantity of urine is thus increased; and, while the kidneys are thus stimulated they may be rendered the means of excreting other matters, though in a very different condition from their existence in the blood (§ 408).

426. In morbid states of all the principal organs the urine is remarkably liable to change. This arises from various causes. If the stomach be the primary seat of disease, or, if its condition be disturbed by reflected nervous influences of other diseased organs, as is almost constantly the case, digestion is imperfectly performed, and the chyle, in consequence, becomes more or less unfitted for the purposes of nutrition and secretion. The kidneys, therefore, carry off more than their wonted quantity of excrementitious matter, while this matter appears under conditions more or less varied from the natural product (§ 425). The whole office of appropriation is, also, more or less impaired, which farther modifies the condition of the blood and the formative action of the kidneys; though a part of the office of excretion, under these circumstances, devolves upon the skin and lungs (§ 416). A third great cause of the variableness of the urine consists in unusual vital decomposition or wasting of the body, or of some of its parts, when it devolves upon the kidneys to co-operate, beyond their natural habit, with the lungs and skin, in removing the redundancy of waste materials. A fourth cause of the urinary changes, and an important one, lies in actual morbid states of the kidneys themselves. The kidneys, however, are not often the seat of morbid affections beyond those of a simple functional and transient nature, as induced by reflex nervous actions excited by the diseases of other parts; but to which influences the kidneys are extremely liable, and, therefore, to consequent modifications of the urinary product.

427. Briefly, then, every alteration of the natural action of the kidneys, whether primary or sympathetic, and every defect in assimilation and appropriation, is attended by some change in the urine; while an endless variety is imparted to it by the qualities and quantities of the ingesta. From this circumstance, which should have prompted other conclusions, has arisen the belief that the state of the urine supplies some of the most important signs of pathological conditions, not only of the kidneys themselves, but of remote organs with which they may sympathize. From Hippocrates to our day, elaborate disquisitions have appeared concerning the changes of the urine as indicative of particular forms of disease, of their special seats, of the dif-

ferent stages of their rise and decline, and of their degrees of severity and danger. The humoralists were apt to regard the unusual conditions of this product, and other "vitiated secretions," as the disease itself; and in this respect they are imitated by the humoralists of the nineteenth century. Chemistry has been also brought to bear upon the fluctuating states of the urine, and has increased the factitious importance of a symptom which is often as likely to denote some alimentary substance, or divers forms of disease, or imperfect digestion, or some remedial agent, as the source from which it emanates.

But, coming to the bed-side we find that all these critical observations are relics of the speculative ages of humoralism. Here, we find that all that is practically useful in relation to the urine is generally best ascertained by mere inspection; and upon this subject, we have all, and more than is desirable, from Hippocrates himself. Those philosophers, however, who are employed in interrogating disease by chemical analyses are not often or long in the chambers of the sick. They carry on the investigation of morbid processes in the laboratory of the chemist, and then and there fabricate the appropriate reagents (§ 5½, *a*). He who studies organic nature according to the method of solidism and vitalism has neither the leisure for those most difficult, unattainable, and laborious analyses, nor would they have any influence upon his judgment as to the pathology or treatment of disease, in the midst of such a multitudinous variety as is presented by the vital phenomena of disease. Of one thing, also, we may rest assured, that nature has supplied all those ready means for interpreting disease that may be necessary for immediate action; nor can we often delay the treatment of acute disease for consultations with the laboratory. In respect to the blood, were it even practicable to learn from analysis its variable conditions in disease, it would reflect no light upon morbid states of the organs, since the qualities of that fluid vary with every varying change in the vital conditions of the solids, and therefore, too, would fail to indicate, in the least, the appropriate remedies. This is also true, in a general sense, of the urine and all other excretions, and secretions. The ready sight, their sensible properties, the vital phenomena, physical signs, experience, and general principles, must be our guide. These may be sometimes facilitated by extraordinary modes of observation, but which are always within the reach and clear understanding of every practitioner; such as the usual mode of examining the blood in inflammatory diseases, evaporating the urine in diabetes, &c. On the contrary, were the humoral doctrines correct the teaching and the practice of medicine should be restricted to chemists alone; since there is no branch of inquiry so difficult as organic analyses, while their uncertainty would soon imply that the *vis medicatrix naturæ* is the only ordination of nature for the maladies of the human race (§ 691, 1033 *b*).

428. The *menstrual fluid* is another and a fourth product of excretion; and, from its close resemblance to the blood, in the human species, it is one of the proofs that capillary hemorrhage is generally the result of a secretory process. In the higher orders of animals, even a clearer index of its origin is supplied by the intermixture of blood with the periodic secretion of mucus, which, in lower orders, occurs without blood. The menses, however, is a product *sui generis*, and is

specifically determined by the nature of the part (§ 135). Unlike the other products of excretion, it is not essential as an evacuation, though important to the function of generation. It is therefore peculiar, also, in exerting important vital influences upon the generative system.

429. At certain periods of the year the female genitals of all animals undergo changes, by which they are developed or prepared for generation; as, for instance, the ovaria of birds become enlarged, the vagina of rabbits and of other animals is tumefied with blood, increased in its vascular action, and pours out an unusual mucous or bloody fluid. It is only at these periods that they are susceptible of impregnation.

430. But woman is capable of impregnation at all times; and that this may happen, her organs must be often developed and prepared for the purpose.

The philosophy of the whole of this preparation, however various in different species, and at whatever intervals of time, is the same in all. The several conditions depend upon changes in the vital states of the generative organs, by which the sexual desire is excited, and the germ rendered susceptible to the stimulus of the semen. This is the end and the aim of the whole.

431. It follows, therefore, that the periodical excretion of the menstrual fluid is only essential to the office of generation, and not to the whole system, excepting so far as this excretion is a healthy function; and the suspension of any function being a morbid condition, the whole system may sympathize with the uterus when the menstrual discharge is suspended.

432. Hence it follows, as a practical result, that all our prescriptions for suspended menstruation must proceed upon the principle that this excretion is a vital, and not a mechanical result; and that its suppression is owing to some morbid state of the uterus, either direct, or sympathetic.

7. CALORIFICATION.

433. Calorification is the function by which plants and animals generate the heat which is peculiar to themselves. Chemistry, however, has enjoyed a more undisturbed exposition of the nature of this function than even that of digestion; nearly all but the most eminent physiologists, such as Hunter and Bichat, having acquiesced in the speculations and assumptions of chemists as setting forth the true philosophy of animal, or, rather, organic heat (§ 333).

It is obvious, therefore, that few things in medical philosophy have greater demands upon the physiologist than a right interpretation of this great and wonderful function of organic life, that its philosophy may be carried to the illustration of other organic processes, that all may be seen as a system of consistent Designs, and that no foot-hold, in the way of analogy, shall remain to him who would substitute artificial devices for the institutions and laws of Nature. The times have, and always have had, a demand upon the physiologist for a critical exposure of this extensive vitiation of medical philosophy. They urge it upon him now more than at former periods. Nothing has been hitherto done but to express opinions; and we now witness, as a consequence, an almost universal substitution of the chemical and phys-

ical theories of life, disease, and therapeutics, for the promptings of the most obvious phenomena of Nature. Mankind, in masses, in the aspect of Nations, are carried away by the simplicity of the chemical dogmas, and by the confidence with which they are uttered. They have become incorporated in most of our works on Physiology, Medicine, Hygiene. Nor is this at all limited to the Medical Profession. It is coextensive with society. It is ingrafted upon popular works; carried into our colleges, academies, and even public schools. It has become a part of the general plan of elementary education; and it is now most extensively an object, through voluminous publications, to induce the whole race of mankind to regulate their food by chemical analysis. Banners, I had almost said, are every where paraded, bearing the inscription from Liebig's Animal Chemistry, that

"To determine what substances are capable of affording nourishment, it is only necessary to ascertain the composition of the food, and to compare it with the ingredients of the blood."

434. At the very outset of our inquiry, we discern the speculative nature of the chemical philosophy from the vast difference in the several hypotheses which have been advanced with equal confidence, and which, for awhile, have been received with almost universal favor. The theory of Crawford, which is relative exclusively to the lungs, and to the difference in the capacity for heat of venous and arterial blood, will not soon lose its fascinating simplicity nor the plausibility of its pretensions. Its elegance will stand forever in forcible contrast with that deformity which is the idol of the present day. Genius and taste will never cease to do their mournful homage to one, while they turn from the other as from the distortions of a Pagan deity.

A third hypothesis may be stated as contributing to the improbabilities of the whole, and which has not yet been fully supplanted by the greater novelty. This is that which ascribes the evolution of organic heat to the passage of the common nutritive fluid to a solid state. It has, even more than Crawford's, the merit of philosophical simplicity, and of an apparent foundation in nature, but far less of the spice of genius.

435, *a*. The first two of the foregoing hypotheses have, as one of their indispensable elements, the union of the oxygen of the air with the carbon of the blood, or with that of the body; though, as I have endeavored to show in the Medical and Physiological Commentaries, neither that act in respiration, nor the excretion of carbon, has any greater connection with the production of animal heat than it has with that of the gastric juice, or any other result of organic functions. The whole of that subject is investigated so extensively in the work just mentioned, and, I may say, the speculations and assumptions which have been subsequently put forth by Liebig and his school are, also, so fully considered in the same work, either as already extant, or as likely to ensue, that I shall now limit myself to a statement of the latest and most approved positions of chemistry, and to such remarks and prominent facts as may be necessary to complete the integrity of those fundamental principles which are the main objects of this work, and to show that nature operates in her several departments, respectively, by general and not by partial laws, and that a

stable and perfect foundation may be thus laid, as it exists in nature for the great superstructure of pathology and therapeutics (§ 2, 892)

435, *b*. The arguments and the facts which I have employed in the foregoing Essay on Animal Heat must have been oftener approved than avowed, since they have been freely adopted by some subsequent writers without indicating the source from whence they were derived (§ 906, *g*).—See RIGHTS OF AUTHORS p. 919, no. 23.

435, *c*. I may be also permitted to make the following extract from the Preface to the third volume of the Medical and Physiological Commentaries, published four years subsequently to the first two volumes. Thus:

"In respect to chemistry, the author may safely affirm that not a fact has been subsequently disclosed that reflects the smallest light upon physiology or pathology. The whole of that ground, wherever chemistry has obtruded itself upon the science of life and disease, is so amply explained in the former volumes of these Commentaries, that not a substantial fact, nor a vague conclusion, has been put forth by the school of Liebig, which is not there examined, anticipated, and answered, as something which had already an existence, or was likely to emerge from the speculative philosophy of the laboratory then in almost universal vogue" (§ 1 *b*, 350¼, 820 *c*).*

436. What, therefore, I may now say in refutation of this or of other chemical doctrines of organic processes and results, will consist, in part, of a summary view of some of the facts and arguments which are arrayed in copious detail in the Medical and Physiological Commentaries. And, truth being my only object, I shall begin the subject under consideration with a statement of the opinions of some of the most accurate and distinguished observers, which correspond with my own. But to show, however, that nothing but opinions have been expressed even by those who have comprehended the subject, I shall quote from each author all that I have any knowledge of his having said upon the question at issue, with the exception of the little which occurs along with Hunter's observations upon the temperature of trees. I will add, also, in proof of the necessity of these inquiries, that no preceding attempt had been made to show the errors of the chemical doctrines of *digestion*, and that I have incorporated in my prefatory remarks to that investigation all that I could learn from the distinguished authors whom I have there summoned in behalf of philosophy.—See RIGHTS OF AUTHORS p. 919, no. 22,

437, *a*. Let us, then, hear the great French physiologist. "The extrication of caloric," says Bichat, "is a phenomenon exactly analogous to those of which the general capillary system is the seat."—"The disengagement of caloric is *always subordinate to the state of the vital forces.*"—"The state of respiration has no influence upon the actual heat of the body."—"When we place on one side all the phenomena of animal heat, and on the other the chemical hypothesis, it

* That this opinion is not peculiar to myself appears from critical notices of the *Commentaries*. Thus, for example, it is said by the distinguished author of the "*Climate of the United States and its Endemic Influences*," that,

"It will be seen that DR. PAINE, in fact, anticipates the whole chemical theory of Liebig, as set forth in his '*Animal Chemistry*.' This he does not only in his *Essay on Vitality*, in which he controverts some of the German professor's opinions, advanced in the '*Organic Chemistry applied to Agriculture and Physiology*,' but likewise in his *Medical and Physiological Commentaries*, published before the appearance of either of LIEBIG's works."

appears to me so inadequate to the explanation that *I think every methodical mind can refute it without my assistance.*"—BICHAT'S *General Anatomy applied to Physiology and Medicine.*

437, *b.* John Hunter, like Bichat, placed the elaboration of organic heat upon the same vital grounds; regarding it as a secreted product. "It is most probable," he says, "that the power of generating heat in animals arises from a principle so connected with life, that it can, and does, act independently of circulation, &c., and is that power which preserves and regulates the internal machine."—HUNTER'S *Observations on Certain Parts of the Animal Economy.*

437, *c.* And thus Wilson Philip: "Among the secretions I have ranked the evolution of caloric, although not taking place on any particular surface, because it appeared to be performed by the same power acting on the same fluid; and because, like secreted fluids, it fails when any considerable part of the influence of the brain or spinal cord is withdrawn."—PHILIP'S *Experimental Inquiry into the Laws of the Vital Functions* (§ 446, *b*).

437, *d.* And thus the philosophical Moore: "We must allow the bodies of living animals and vegetables to form an original source of heat, as much beyond our power of explaining as the source of the sun's heat."—MOORE'S *Medical Sketches.*

437, *e.* And Müller thus: "From the experiments of Dulong and Despretz, it results that, even if the chemical theory of respiration be adopted, *there must be still some other source of animal heat.*" "A general source of animal heat is *undoubtedly* to be found in the *organic processes*, in which, by the *organizing forces* on the organic matter, heat is generated not in one, but in every organ of the body." Again, "Since all organic processes are chiefly dependent on the influence exerted by the nerves on the organic mattter of the body, it cannot appear wonderful if the reciprocal action between the organs and the nerves is a main source of animal heat."—MÜLLER'S *Physiology.*

437, *f.* Tiedemann has the same view of the subject. "The only point," he says, "that can be regarded as placed *beyond doubt* is, that the evolution of heat is a *vital act* which depends immediately on the process of nutrition, the conditional and preservative cause of life. The intensity of the evolution of heat, and the property of maintaining itself at a certain temperature proper to each species, are, in animals, in direct ratio with the composition of their organization, and with the sum and intensity of their manifestations of activity."—TIEDEMANN'S *Physiology.*

437, *g.* Finally, it is even said by the distinguished chemical physiologist, Dr. Carpenter, that, "It is evident that the chemical doctrine in its present form is insufficient to explain the phenomena of animal calorification."—CARPENTER'S *Human Physiology*, p. 611. *London*, 1842.

438, *a.* The very able Dr. Edwards, in his work on the *Influence of Physical Agents on Life*, maintains that "*respiration and animal heat stand related as cause and effect.*" This doctrine is maintained by Edwards with great ability; far more so than by all other authors whom I have consulted. I thought it, therefore, important to dispose of his facts and arguments, in my former work, as far as their plausibility and my own advantage of the right position would admit. There is much said, in the Commentaries, in refutation of that doc-

trine, which is at the foundation of Liebig's (§ 440), and to which no farther reference will be made in this work (§ 1044).

438, *b*. Coming to the heterogeneous assumptions which distinguish the school of Liebig, there was no difficulty in anticipating the nature of such as might be relative to former theories. I had set forth the various doctrines in their ample dimensions, and brought them to the test of facts and philosophy. The combustion theory was then in vogue, and nearly in the terms as expounded by Liebig. In descanting upon its peculiarities I took for my guide the most recent and approved phraseology, which, it will be seen, is coincident with the supposed novelty; and, although it had numerous and ardent admirers, it passed into such oblivion, in the brief space of two years, that when Liebig promulgated the same hypothesis, and in the same language, it was hailed as one of the most brilliant achievements of that distinguished man (§ 349, *d*). The doctrine which had been thus nearly expressed by Billing, in his "Principles of Medicine," was taken for my text, and is now presented again, in its original typography. Thus:

"We have in the LUNGS a CHARCOAL FIRE constantly burning, and in the OTHER PARTS a WOOD FIRE, the one producing *carbonic acid gas*, the other *carbon;* the *food supplying*, through the circulation, the vegetable or animal *fuel*, from which the *charcoal* is *prepared* that is *burned* in the *lungs*. It is thus that animal heat is kept up."—BILLING, 1838 (§ 447½ *a*, no. 4, 1044).

438, *c*. Somewhat prior to Billing's *day*, Roget had embellished his "Bridgewater Treatise on Animal and Vegetable Physiology," by the following graphic description of the apparatus, and the office which each part fulfills in the generation of animal heat. Thus:

"The food supplies the *fuel*, which is prepared for use by the *digestive organs*, and conveyed *by* the pulmonary arteries to *the place* where it is to undergo *combustion*. The *diaphragm* is the *bellows* which feeds the *furnace* with *air;* and the *trachea* is the *chimney* through which the carbonic acid, which is the product of combustion, escapes."—ROGET (§ 350¾, *f*).

438, *d*. Now, the only fundamental difference between the foregoing and Liebig's hypothesis is this: The former supposes the combustion to take place in the lungs, the latter in every other part *excepting the lungs*, where, as will be seen, a special provision is made for the temperature of those organs (§ 447½, *f*).

That no imaginary obstacle may lie in the way of the vital theory, and that truth may have the advantage of rival doctrines by their close apposition, and that knowledge may not be limited to the facts and deductions of unadulterated science, it remains to show, by a series of quotations from Liebig's Animal Chemistry, that the doctrine of the dependence of organic heat upon the chemical process of combustion has gained nothing from the Laboratory at Geissen; while the attentive reader will find in the extracts themselves the most ample proof of its untenable nature. This, indeed, may have been well anticipated from what I have shown of this philosopher's regard for facts and consistency in section 350. Indeed, the same incongruities, the same contradictions, and worse assumptions, go to form the whole fabric of Liebig's disquisitions upon animal heat, as I have shown to make up his jumble respecting digestion, and other great functions, as well as properties of living beings (§ 1044).

I shall endeavor to execute my task with the same efficiency as was attempted in relation to the chemical views of digestion (§ 350), in the earnest hope that the chemist may discern the error of his ways, and leave to the student of Organic Nature those difficult problems which concern the highest welfare of man, and whose consistency, in their philosophical bearing, cannot be disturbed without laying in ruins every principle in physiology, and carrying death into the chambers of the sick (§ 4 *a*, 5, 5½ *a*, 376½, 376¾ *b*, 819, &c.)

440, *a*. Let us begin, then, with a statement of the doctrine as summarily delivered by Liebig in his work on *Animal Chemistry*, and we shall see from the first proposition that it is essentially the old speculation (§ 438, *b*), alike based upon artificial expedients, and upon the assumption that the living organism is a mere chemical apparatus, destitute of all properties and laws that are not common to dead matter.

1. "It is evident that the supply of heat lost by cooling is effected by the mutual action of the elements of the food and the inspired oxygen, which combine together. The animal body acts, in this respect, *as a furnace which we supply with fuel*." "In order to keep up in the furnace a constant temperature, *we must vary the supply of fuel according to the external temperature, that is, according to the supply of oxygen*."—*Animal Chemistry*.

It will be seen, from the close of the foregoing quotation, that a capital error is made in assuming a law that the quantity of food is regulated by the temperature of the air (§ 440 *cc*, *no.* 12). That assumption is carried out in opposition to all well-known facts; while it is also assumed as a law, that animal heat, whatever its uniformity in the warm-blooded animal, or its instability in the cold-blooded, depends upon the relative law of the temperature of the air and the quantity of food consumed, although this law is virtually contradicted by various other requisites for the promotion and maintenance of animal heat. But let us have another unqualified proposition which defines the law in relation to the dependence of animal heat upon external temperature and the food consumed. Thus:

2. "In different climates, the quantity of oxygen introduced into the system by respiration varies according to the temperature of the external air. The quantity of inspired oxygen increases with the loss of heat by external cooling, and the quantity of carbon or hydrogen necessary to combine with this oxygen must be increased in the same ratio."—*Animal Chemistry*.

Now compare the following, 3, 4, and 5, with the preceding 1 and 2, and observe the conflict between them, and the contingencies upon which the great law is made to depend that determines a uniform temperature. Thus:

3. "The *quantity of oxygen* consumed varies according to the temperature and density of the air, according to the degree of motion, labor, or exercise, to the amount and quality of the food, to the comparative warmth of the clothing, and also according to the time within which the food is taken"! A proposition mostly relative to man, and unfounded as to him (§ 440, *c*).

4. "*The quantity of food* is regulated by the number of respirations, by the temperature of the air, and by the amount of heat given off to the surrounding medium"! (§ 447, *c*).

5. "*The mutual action between the elements of the food and the oxygen conveyed by the circulation of the blood to every part of the body* IS THE SOURCE OF ANIMAL HEAT." "*For a given amount of oxygen the heat produced is, in all cases, exactly the same.*"—LIEBIG'S *Animal Chemistry* (§ 447, *c*, 1048).

6. "There is not the smallest support to the opinion that there exists, in the animal body, any other unknown source of heat, besides the mutual *chemical action* between the elements of the food and the oxygen of the air."—*Animal Chemistry.*

No farther comment is necessary to indicate the complexities and contradictions involved in the foregoing quotations; such as "the quantity of oxygen consumed depends on the amount and quality of the food," while "the *quantity of food* is regulated by the number of respirations," that is, by "the quantity of oxygen consumed," &c.

If, also, we now add to the foregoing, 1, 2, 3, 4, 5, 6, other contingencies upon which it is assumed that animal heat depends, we shall have such a variety of accidental circumstances to interpret the uniform temperature of *each individual* of every species of animal, and that, too, according to the constitutional peculiarities of each species, that the nature of the chemical rationale will be sufficiently obvious. Thus:

7. "Where the food contains meat, fat, and *wine*, by reason of the hydrogen in those kinds of food which is oxydized, and which, in being converted into water, it evolves much more heat for equal weights."

8. "The cooling of the body, by *whatever cause* it may be produced, increases the amount of food necessary. The mere exposure to the cold air, &c., increases the loss of heat, and *compels* us to eat more than usual. [!] The same is true of those who are accustomed to drink large quantities of cold water. It increases the appetite, [!] and persons of a weak constitution find it necessary, by continued exercise, to supply to the system the oxygen required to restore the heat abstracted by the cold water" !—*Animal Chemistry.*

440, *b*. Here I pause for a moment to advert to the ground of the assumptions in the quotations 7 and 8. The reason is one which goes conclusively to the vital theory of animal heat. When wine, for example, is taken into the stomach, an evolution of heat ensues as soon as the stimulant is swallowed, in virtue of its stimulant effect on that organ. In the same way meat stimulates more than vegetables, and will light up a glow upon a cold surface before its digestion has begun (§ 512, *b*). In respect to the superiority of cold water in provoking hunger, there is no other way of explaining the philosophy against the fact than by supposing "the Reformer" was pledged to the popular cause of temperance. But since wine, brandy, &c., far more than cold water, "increase the appetite" and "compel us to eat more than usual," and since these fluids are said to yield a far greater amount of "fuel" to the system than the food itself (whose main object is also supposed to supply the means of combustion), it should follow, upon our author's premises, that less food would be necessary to the purposes of life in proportion to the quantity of alcohol consumed, and therefore that wine should, in reality, diminish the appetite and "compel us to eat less than usual" (nos. 4, 7; § 441, *e*).

It may be worth observing, also, in respect to the "cold water," that the assumption is foundec upon several important mistakes;

namely, 1st. That the appetite is virtually regulated by the condition of the calorific process; 2d. That "the animal body bears the same relation to surrounding objects (in respect to an interchange of caloric), as any other heated mass" (no. 14); and, 3d. That drinking cold water diminishes the temperature of the body (§ 442, *b*, *c*, *d*, *e*). And the most strenuous and extensive efforts have been made to choke down these absurdities under the penalty of being lampooned as an enemy to "experimental philosophy" (§ 5½, *a*). I have no doubt, however, that they will forcibly remind the reader of the parallel quotations, and of the pathological and therapeutical principles which emanate from them in the two subsequent sections.

440, *bb*. As to the "fat" (no. 7), the chemist assumed that to be an important source of animal heat because it is one of the best substances for combustion "in the air or in oxygen gas" (no. 10); and this hypothesis conducts him to the ludicrous mistake of regarding it equally, and in the same aspect, as a source of animal heat, whether it be taken as an article of food and converted into chyme, or consist of food which has been converted into the fat that makes up a part of the consumer. The uniform temperature, therefore, among a variety of other things, will depend not only on the amount of fat eaten, but on the amount formed out of the blood. This leads our author to say that,

9. "If we were to go naked, like certain savage tribes, or if in hunting or fishing we were exposed to the same degree of cold as the Samoyedes, we should be able with ease to consume ten pounds of flesh, [!] and perhaps a dozen of tallow candles into the bargain, daily, as warmly-clad travelers have related with astonishment of these people. [!] We should then, also, be able to take *the same quantity of brandy* or train oil *without bad effects*, because the carbon and hydrogen of these substances would only suffice to keep up the equilibrium between the external temperature and that of our bodies."—*Animal Chemistry* (§ 1050). And yet *Alcohol* is not absorbed § 350, no. 94.

And that, too, in a critical work on science which professes a rigorous adherence to facts, as the only apology for a contemptuous derision of long-established doctrines, and as the only basis for the attempted substitutes. But let us now turn from "fat" as a combustible substance, *via* the digestive apparatus, to "fat" as appertaining to the organized tissues (§ 1048, 1049).—NOTE N p. 1121.

10. "The formation of *fat* depends on a deficiency of oxygen. But, in this process, in the formation of fat itself, there is opened up *a new source of animal heat.* The oxygen set free in the formation of fat is given out in combination with carbon or hydrogen, and there must have been generated by the formation of carbonic acid or water as much heat as if an equal weight of carbon or hydrogen had been burned in air or in oxygen gas."—LIEBIG'S *Organic Chemistry*, &c.

Introductory to the foregoing quotation, we are told, that,

"The production of fat is always a consequence of a deficient supply of oxygen, for oxygen is absolutely indispensable for the dissipation of excess of carbon in the food."

And then we are referred, in illustration, to the "lean, muscular, sinewy limbs that are exhibited with pride by the Bedouin and Arab of the desert" (*c*). But what says the variety in respect to fat, and oxygen and heat, that prevails among the tenants of the ocean, who have but one

common supply of food? Contrast, for example, the blubber of the whale, who breathes with lungs, with many a lean, voracious, cold-blooded animal that respires with gills. The hypothesis, therefore, falls (no. 11½, and § 443, *b*). Or, if it survive such difficulties, take, then, the following statement, designed as an important basis for the combustion theory, and which should have had a place among our author's pathological doctrines (§ 350½). But our present interest lies in the fact that it appears, after all, that it is not "true without exception," that "the production of fat is always in consequence of a deficient supply of oxygen." Thus:

"Exercise and labor cause a diminution in the quantity of the menstrual discharge; and when it is suppressed in consequence of disease, the vegetative life is manifested in a *morbid production of fat*"!

Here is another "most trustworthy observation," and "perfectly conclusive" as to our author's doctrine. Thus:

"The quantities of oxygen which a whale and a carrier's horse can inspire in a given time are very unequal. The temperature, as well as the quantity of oxygen, is much greater in the horse."—LIEBIG'S *Animal Chemistry*, &c.

Now the temperature of the whale in the frozen seas is more than 100° Fh., nor can the "carrier" bring up that of his horse to a higher degree, with the aid of a tropical sun. It is evident that our author has regarded the whale as a cold-blooded fish.

440, *c*. I shall not now stop to inquire farther into the factitious nature of the foregoing doctrine, but go on with other extracts in which the author endeavors to sustain his great law of animal heat (5, 6), and expound by other contingencies that exact temperature which distinguishes every warm-blooded individual of every species of animal, and according to the nature of the species, and with scarce a variation, at all seasons, in all climates, at all ages, with all kinds and quantities of food, from him who "devours 10 lbs. of flesh and a dozen tallow candles into the bargain, daily, and the same quantity of brandy and train oil without bad effects" (no. 9), to him who, like "old Cornaro," lives on "half an egg a day;" and whether clad in the flannels and woolen broadcloths that are preferred as matters of comfort by many inhabitants of tropical climates, or absolutely naked, with Fahrenheit at 40° and lower, like the Petcherai Indians (442, *b*); or, whether sleeping or waking, sitting or standing, running or walking, in an ice-house or in an oven, in all past time, now, and forever; whatever statements our "Reformer" may make to the contrary notwithstanding. It will appear, therefore, that the following affirmations should be carefully considered, before they are admitted as appendages to the general law; namely,

11. "Our clothing is merely an equivalent for a certain amount of food. [!] The more warmly we are clothed the less urgent becomes the appetite for food, [!] because the loss of heat by cooling, and consequently the amount of heat to be supplied by the food, is diminished" (no. 9, and 12, and § 442 *a*, *c*, 1047, 1048, 1049).

Here our author predicates two important errors of the hypothesis which they are intended to sustain; the assumptions and the hypothesis being mutually designed to support each other.

11½. But again; having seen that (in the language of Mr. Ancell, "the Reformer's" interpreter) "the *deposition* of fat is supposed to

act as a *substitute for free respiration* in the production of heat" (no. 10), we shall not be surprised to learn that "its *absorption* answers as a *substitute for food* in the production of animal heat." So it is extensively affirmed in the work on *Animal Chemistry*.

Why, then, is the temperature of a very fat ox and a very lean one, or of a very fat man and a very lean one, exactly the same in each species, respectively? Why does the fat man sustain a much less exaltation of heat than the lean one when emaciation is in rapid progress in febrile diseases? Why those daily periodical evolutions of heat (100° to 110° Fh.) in the emaciated subject of phthisis, subsisting on barley-water; and respiring with lungs unfitted for half their usual functions? And this leads me to state the chemical philosophy of mania and delirium, which flows immediately from the subject before us; and by which we learn, also, what is more important, the extent of our author's theory of combustion. Thus:

"In the progress of starvation it is not only the fat which disappears, but also, by degrees, all such of the solids as are capable of being dissolved. In the wasted body of those who have suffered starvation the muscles are shrunk and unnaturally soft, and have lost their contractility. All those parts of the body which were capable of entering into a state of motion have served to protect the remainder of the frame from the destructive influence of the atmosphere. [!] Toward the end, the particles of the brain begin to undergo the process of oxydation, and *delirium*, *mania*, and death, close the scene."

This construction of the cause of delirium and mania is conformable to the author's hypothesis of thought, mental emotions, &c. (§ 349, *e*); but that the phenomena are due to totally different influences "in the progress of starvation" is shown by the uniform preservation of the intellectual powers in the most emaciated subjects of phthisis pulmonalis (§ 441, *c*).—See INDEX II, Article *Hunger*.

440, *cc*. But, we are only beginning with the contingencies which contribute to the fundamental principle of animal heat, and which are designed to interpret its remarkable uniformity, yet variety, in different species of the warm-blooded tribes, and its variableness in the cold-blooded, and to bring the general doctrine into correspondence with a great law of caloric which prevails in the inorganic world (§ 440 *e*, no. 14).

12. "In cold and temperate climates, the air which incessantly strives to consume the body [!] urges man to laborious efforts in order to furnish the means of resistance to its action, while, in hot climates, the necessity of labor to provide food is far less urgent" (§ 445, *b*).—*Animal Chemistry*.

In the first place, all animals are overlooked in the foregoing statement, and our philosopher is actually regarding man as the only living creature who has a temperature above the surrounding atmosphere; for it surely will not be said of animals that they must work harder for a supply of food in temperate than in warmer climates. Nor will the reader fail to observe that much of the statements and reasoning, throughout, is predicated specifically of man, and of man, too, in a state of health.

As to the necessity of more "laborious efforts to provide food" in cold than in hot climates, a very different philosophy lies at its bottom than assigned by Liebig, which consists in the greater necessity of

labor to cultivate the earth and raise the means of supply in the former than the latter sections of the globe. It is evident, also, that "the Reformer" had not only man exclusively in view, but in that part of the contrast which relates to "hot climates," he was thinking alone of the indolent and luxurious master, without reference to the slave, who toils the day long under a torrid sun for his own scanty subsistence and his master's too.—NOTE Oo p. 1141.

But again, although man be compelled to work in cold climates "to provide food" to keep up his temperature, while this "necessity for labor is far less urgent in hot climates," the cold-blooded finny tribe, and the warm-blooded whale, and beasts of prey are quite on an equality, in that respect, in all regions of the earth.

440, *d*. But, we are yet far from the end of the "contingent influences" which modify the exact law of animal heat (nos. 5, 6), and which go to the preservation of its exact uniformity. One of our author's hypotheses, which will be soon stated (no. 14), betrays him into a mistake, which has been often made and as often exposed. Thus:

13. "*The contraction of muscles produces heat;* but the force necessary for the contraction has manifested itself through the organs of motion, in which it has been excited by chemical changes. The ultimate cause of the heat produced is, therefore, to be found in these chemical changes."—*Animal Chemistry.*

Now, setting aside the sophistry of this reasoning in a circle, we have the simple proposition that "*the contraction of muscles produces heat;*" and evidently because "a piece of caoutchouc, when rapidly drawn out, forcibly contracts again, with disengagement of heat." And to this conclusion the "Reformer" was impelled by his fundamental doctrine that the living and the dead are undistinguishably governed by the same properties and laws, as implied by no. 14, and as extensively set forth in § 350. This assumption as to the effects of muscular motion I have sufficiently noticed in my former Essay on Animal Heat; but it may be now said that it is disproved by the uniformity of animal heat in all warm-blooded vertebrata, under all circumstances of rest and exercise. When the latter is sufficient to give an impulse to the general circulatory and other organs, an increased evolution of animal heat is liable to happen, like an increased flow of saliva, sweat, or any other secreted product; but it does not happen with any certainty, and is never due to the physical causes assigned; neither the mechanical one of "muscular contraction," nor the "chemical changes."

440, *e*. I come now to one of our philosopher's parallelisms of organic and inorganic beings in respect to their great laws and functions, and which necessarily flows from the grand physical hypothesis that the living body is a mere chemical apparatus. Thus:

14. "The animal body is a heated mass, which bears THE SAME RELATION TO SURROUNDING OBJECTS AS ANY OTHER HEATED MASS. It receives heat when the surrounding objects are hotter, it loses heat when they are colder than itself."—*Animal Chemistry.* (See § 350$\frac{2}{3}$, *e*, 1044 *a*, *b*).

Thus we have throughout a consecutive series of mistakes and blunders, emanating from a false position in respect to the fundamental constitution of living beings; while this perversion of nature is the monomania of materialism. But there remains much of the like nature yet in prospect.

From the last proposition, and from the common level in which living and dead objects are regarded, and in his unacquaintance with physiological facts, the chemist has been betrayed into the supposition that all the contingent circumstances which I have now stated (nos. 1–14) contribute, along with the fundamental law, 5 and 6, to the production and maintenance of that uniform temperature by which every warm-blooded vertebrata is distinguished, while every other product of the tissues is forever variable in quantity, and which are to explain equally, also, the vicissitudes of the cold-blooded race, and all the diversities of temperature which spring from disease.

The plainest facts in "experimental philosophy" contradict the assumption, and place the generation of animal heat upon its own independent ground. If we enter an apartment heated to 260° F., the temperature of the body remains unaffected; and equally so in a bath of water, where all evaporation is prevented. If we pass the day in an ice-house, or dwell in an atmosphere at 50° below the zero of Fahrenheit, it is all the same (§ 442, *c*, *d*). If water, at zero, be dashed on the body, a glowing heat is instantly lighted up on the surface; and so it is upon the cold and shriveled skin of the starving man as soon as food shall have entered his stomach. A flash of indignation, or an impulse of shame, will, on the instant, set the whole face in a state of "combustion;" the face being then said, by common consent, to "burn" (§ 441, *c*).*

With the last proposition (14) goes another which has the concurrence of all; namely,

15. "The heat given off to the surrounding medium is restored within the body with great rapidity."—"All living creatures, whose existence depends on the absorption of oxygen, possess within themselves a source of heat independent of surrounding objects."

16. And (for the third time, 5 and 6), "This disengagement of heat is, uniformly and under all circumstances, the result of the combination of a combustible substance with oxygen."—*Animal Chemistry.*

Such a chemical machine, with an internal source of heat, and constantly liable to elevations and depressions of temperature from "surrounding objects like any other heated mass," could possess no stability of temperature,—none comparable with the inanimate objects by which its own internal source of heat is said to be influenced; and when we superadd the various other contingencies, the varying quantities and qualities of food, variableness of respiration, the oxygen respired, clothing, climate, season, weather, rest or exercise, age, fat, candles, train oil, and rum, which are said to have important influences on animal heat (nos. 1–14), and then carry out the assumed relation of the living body to "surrounding objects," and thus identify it with a "heated mass" of iron, a thousand other modifying contingencies present themselves, which, in connection with the "internal independent source of heat," should render the temperature of the living warm-blooded vertebrata variable at every moment, while that of the cold-blooded animal should be distinguished by the greater uniformity.

It need scarcely be added, that the warm-blooded vertebrata are remarkably exempt from the law which chemistry, to be consistent, imputes to them as conductors of caloric (no. 14). And herein, as

* How absurd does the doctrine of combustion appear in the presence of those *Mental Emotions* which instantly light up a glow on the surface of the body!

every where else, chemistry betrays the fallacy of its fundamental assumption (nos. 5, 6, 16). The warm-blooded vertebrata are especially contradistinguished from "*other heated masses*, in their relation to surrounding objects," by their resistance of heat from external objects (§ 441 *c*, 442 *e*); and this contradistinction is not only shown by universal experience, but forcibly so by the comparative relation which cold-blooded animals and "other heated masses bear to surrounding objects." These animals depend mostly for their temperature upon that of the surrounding medium, and consequently sustain much of the relation of "other heated masses." Still, they possess not only a feeble power of generating heat, but, what is more to my purpose, they have a corresponding power of resisting its ingress from surrounding objects, since it was ascertained by Crawford that "*a living frog acquires heat more slowly than a dead one.*"—*London Philosoph. Trans.*, 1781, p. 485.

It is also worthy of remark, that the chemist has mistaken the rise of animal heat, when occasioned by the heat of a fire, for that interchange of caloric which takes place between inanimate substances of different temperatures. The phenomenon is peculiarly a fact for the vitalist, since, in the former case the rise of heat is due to the action of caloric as a stimulant to the organic functions (§ 188½).

On the other hand, when the temperature falls from the direct action of cold upon the living body, it is from the abduction of heat from the superficial capillaries alone, by which the calorific function is arrested not only in the skin, but may be, by reflex nervous action, throughout the body. And what also forcibly shows the vital nature of this phenomenon is the frequent and speedy exaltation of the cutaneous heat after its sudden reduction by the application of cold water (§ 1044).

440, *f.* In the midst of so much error and confusion, it is no difficult matter, as already seen (§ 350), to paralyze an author by an exposure of palpable contradictions in fundamental doctrines. As an example of this nature in relation to the present subject I shall place in opposition the following statements:

Affirmative.	*Negative.*
17. "In whatever way carbon may combine with oxygen, the act of combination cannot take place without the disengagement of heat. *It is a matter of indifference whether the combination* take place at a HIGH OR AT A LOW TEMPERATURE; the amount of heat liberated is a constant quantity."	18. "Carbon never combines at common temperatures with oxygen, so as to form carbonic acid."
"In the foregoing pages, it has been assumed that it is especially CARBON and hydrogen which, *by combining with oxygen*, serve to produce animal heat."	"There is NO EXAMPLE of *carbon combining directly with oxygen at common temperatures;* but numerous facts show that *hydrogen*, in certain states of condensation, possesses that property. *Lamp-black which has been heated to redness* may be *kept in contact with oxygen gas, without forming carbonic acid.* The spontaneous inflammability of the charcoal used in the fabrication of gunpowder has been correctly ascribed to the hydrogen which it contains in considerable quantity; for during its
"The carbon of the food, which is converted into carbonic acid within the body, must give out exactly as much heat as if it had	

been directly burned in the air or in oxygen gas."

"The 13·9 oz. of carbon which are daily converted into carbonic acid in the body of an adult, evolve 197477 degrees of heat, which is sufficient to raise the temperature of 370 lbs. of water to 98·3°, the temperature of the human body." — LIEBIG'S *Animal Chemistry*, 1842. [See, also, nos. 5, 6, 16.]

reduction to powder, no trace of carbonic acid can be detected in the air surrounding it. It is not formed until *the temperature of the mass has reached the red heat.* The heat which produces the inflammation is therefore *not caused by the oxydation of the carbon.*"—LIEBIG'S *Organic Chemistry applied to Physiology*, &c., p. 263, 311.

440, *g*. These contradictory doctrines were put forth in different works, but almost simultaneously, and each was designed to sustain important hypotheses that regarded, respectively, the negative and the affirmative statement. But, even in the work on *Animal Chemistry*, a subject collateral to the general hypothesis of animal heat leads the author to a partial contradiction of his all-pervading idea of the ready combustion of carbon at temperatures as low, at least, as those of cold-blooded animals; since, upon that collateral subject, he says, "*at the temperature of the* (warm-blooded) *body*, the affinity of hydrogen for oxygen *far surpasses* that of carbon for the same element." (See § 441, *e*.)

440, *h*. I shall not undertake to decide whether oxygen unites singly with carbon or hydrogen, in the living body, or along with other elements from which the carbon is ultimately excreted, nor is it the province of these Institutes to inquire into a truth which belongs to the laboratory. In my former Essay on Animal Heat, I have examined this subject in its physiological aspect adversely to the chemical doctrine, and in conformity with the great law which excludes the formation of all inorganic compounds within the living organism, as set forth by chemistry (§ 38, 39, 419).

440, *i*. Of the remaining subsidiary causes, that relative to the bile should not be neglected. It is thus summarily expressed by Liebig's interpreter, Mr. Ancell:

19. "These facts, and the reasoning founded upon them, have led Liebig to the conclusion that the FUNCTION OF THE BILE is to support respiration and produce animal heat, by presenting carbon and hydrogen in a very soluble form to the oxygen of arterial blood."—MR. ANCELL, *in London Lancet*, 1843.

The reader will, therefore, the more readily comprehend the doctrine of "the Reformer" as stated in the following language. Thus:

"In the *carnivora* the bile contains the carbon of the metamorphosed tissues. This carbon disappears in the animal body, and the bile likewise disappears in the vital process. Its carbon and hydrogen are given out through the skin and lungs as carbonic acid and water; and hence it is obvious that the elements of the bile serve for respiration and for the production of animal heat."—*Animal Chemistry*.

That may answer for the "*carnivora*;" while the graminivora depend more upon their "fat," and other tribes upon their special allotments.

Having already adverted to the true uses of the bile (§ 314–316,

409 *f*), I shall proceed to say, without stopping to inquire how the foregoing "facts" were ascertained, that this part of the doctrine will hardly abide the test of morbid conditions. It often happens, for instance, when the production of bile is nearly or wholly arrested, that the temperature of the body is exalted above its natural standard, while at other times, when the bile is redundant, the temperature sinks below its equilibrium. This, too, is familiar to physicians as occurring in the progress of the same disease; and I have thus introduced this subject more for its bearing upon physiology and disease, than on account of its perversion by the chemist (§ 1031 *b*).

441, *a*. Having now set forth the principal doctrine, and the most important contingencies which are brought to its support, I shall proceed to make some farther comments both upon the doctrine and its auxiliaries, and present a variety of facts in confirmation of the physiological theory of animal heat.

441, *b*. In the first place, it is worthy of farther remark in regard to a principal element of the main hypothesis, that scarcely any two individuals, of whatever species, consume the same quantities of food in a given time, while society abounds with habitual examples, where, under the same circumstances of age, health, sex, climate, temperature, employment, &c., there is every gradation in quantity from a daily consumption of many pounds to a few ounces, or with slight variations as to quantity in many individuals. Without, however, now reverting to the preceding relative statements of our author, let us adduce another for the sake of its logic and precision. Thus:

"The consumption of oxygen in equal times may be expressed by the number of respirations. It is clear that in the same individual the quantity of nourishment required must vary with the force and number of the respirations."—*Animal Chemistry.*

Immediately after this quotation, which has for its object an adjustment of "the quantity of nourishment required" for the assumed amount of carbonic acid generated in the body, we are told that,

"A child, in whom the organs of respiration are naturally very active, requires food oftener than an adult."

Thus, therefore, according to this statement (which has the merit of being true, not only as it respects a "child," but all young animals), the author has presented a fact subversive of his hypothesis relative to the source of animal heat; since, if a "child" and all young animals consume more food and oxygen in the ratio of their size than men and adult animals, the power of evolving heat should be greater in the young than in the adult. But the experiments of Edwards, and others, have demonstrated that young warm-blooded animals may be cooled down rapidly to near the temperature of the surrounding air, which is impracticable with adults. But Edwards adds the fact, which farther confirms the vital doctrine of the generation of animal heat, that "*the rapid progress which they make in acquiring the power of producing heat is wonderful.*" The same facts are applicable to a "child," though probably less so than to unfledged birds, puppies, &c. (§ 153–155, 442 *a*, 445 *f*). I may finally add, that the whole of this subject is extensively considered in my former Essay on Animal Heat.

441, *c*. Nor can I neglect referring the reader to the facts which I have arrayed in the Commentaries upon the subject of food, with a view as well to the humoral pathology as to the chemical doctrine of

animal heat,—how the northern savages, as known by observation, and from the necessity of the case, consume much less food than the civilized man of the temperate and even equatorial climates; the former, also, often breaking his fast only at distant intervals. There,* too, may be found a multitude of corresponding facts in relation to the endurance of *Fasting* without any sensible influence on the human system,—a general survey, also, of the habits of animals in relation to temperature, and which, like many of my arguments and other facts, have been advantageously employed by subsequent writers to accomplish what I had already done. I have urged the fact, in respect to animals, that they enjoy, *ex necessitate rei*, but a scanty supply of food in the arctic regions, and that, when gorged with the same sustenance on their removal to warmer climates, they still maintain nearly their original constitutional temperature; and there may be found a series of facts as to the relative temperature of the warm-blooded and the cold-blooded tenants of the deep, which, side by side in the arctic seas, subsist on food of the same quality; the whale, with a temperature of 102° F., and the far more voracious shark, whose heat is down to a lower standard. There it is urged, that when the emaciated hibernating animal is roused by pricking, &c., ay, even by exposure to a still lower temperature, 25° F., his heat suddenly rises from 39° to 97° F.; besides a multitude of similar proofs which should be examined in connection with what I have said extensively on the influence of the *nervous system* upon the generation of organic heat in the warm-blooded vertebrata (§ 1047, 1050).

How poorly accords our author's assumption as to the greater voracity of polar animals with the well-known facts relative to the hyenas, tigers, lions, crocodiles, vultures, *cormorants*, &c., that range in temperate and equatorial quarters! And what answer will chemistry make to the poor ability of all tropical animals to bear even the autumnal cold of the temperate zones, whatever the quantity of food?

But the facts are "the things," and let us, therefore, have them (§ $5\frac{1}{4}$, *a*). They will show how far "the animal body bears the same relation to surrounding objects as any other heated *mass*" (§ 440 *c*, no. 14), and how far a large supply of food is necessary to the same animal temperature in frozen regions as appertains to the inhabitants of warmer climates.

In the *Commentaries*, then, I have called to witness, against the assumptions which I am again employed in refuting, the half-starved bears, and foxes, and reindeers, and hares, and even small birds, subsisting on a scanty amount of half-frozen food, and respiring and surrounded by an atmosphere at 30° to 50° below the zero of Fahrenheit; yet maintaining about the same temperature as when transported to a southern climate. I have said that "in 15 out of 16 foxes, the temperature was 100° to $106\frac{3}{4}$°, in the other 98°; the thermometer ranging below zero from 3° to 32° Fh. Capt. Lyon found that the *tetro albus* maintained its temperature at 50° below zero. It was, also, equally so with the smallest birds" (§ 442 *b*, 446 *d*, 1046–1050).

After what has been stated, however, of "tallow candles," "laborious efforts," "heated masses," "clothing," &c. (§ 440, nos. 9, 11, 12), the reader will not be surprised at our author's statement that, "*every*

* Medical and Physiological Commentaries, vol. i., p. 691–695. Also, the Essay on Animal Heat, in vol. ii.—1840.

one knows that the animals of prey in the arctic regions far exceed in voracity those of the torrid zone." And yet "every one knows" that the consumption of food is universally greatest where it is most abundant, and therefore least where it is assumed to be most abundant.

And what will the disciples of chemistry say to the fact that the low-born of the North of Europe, the exiles of Siberia, &c., often get little more than bread made from the wood of trees, and a wardrobe equally expressive of their destitution of the "comforts of life" (§ 442 *b*, and *Commentaries*, vol. i., p. 691–698)? What is the contrast in temperature between the well-fed loungers of Europe and the half-starved laborers of the same countries? What, again, between the slave and his master? One, too, feasting on animal food and other highly "combustible matter," in the shape of brandy, porter, wine, &c., while the other gets nothing but potatoes, yams, or bread, at best, and limpid water (nos. 7, 8)? Their temperature is alike. The only contrast in the case is between truth and error. Is the balance, then, to be found in the difference of clothing (no. 11)? Exactly otherwise; for the man of ease is incased with flannels and broadcloths, and lives in heated apartments (no. 14), while he of the shovel or the hod is no less contented and comfortable in rags, and whether he repose upon a bed of straw or a bank of snow. And here I may add, what is equally fatal to the chemical hypothesis, that this houseless *sans culottes* will maintain his warmth better with water than with rum, and that, the more he consumes of the "combustible substance," the greater will be his danger from frost (nos. 7, 9, NOTE Oo p. 1141).

It is also manifest that the ever-varying quantities and qualities of food employed by man in temperate and torrid zones, while his heat is always nearly the same, shows, with my other facts, that it is less dependent on food than are other products of organization. More especially is this demonstrated in many acute diseases, where the temperature of the body, or of particular parts only, is often greatly exalted, and where, too, the patient is wholly deprived of food, and emaciation so far advanced that not only the "fat," but the very "tissues" are nearly "consumed."

Without inquiring into the hypothesis that meat is more combustible, and yields a greater quantity of heat than vegetable matter, it is important to place their relations to the calorific function in the proper physiological aspect.

There is no doubt that the generation of heat is more promoted by animal than by vegetable food, until the system is accommodated to the latter by its habitual use; and even then the preponderance will be in favor of the former in high northern latitudes. The principle to which I now advert depends upon the law of vital habit and that which relates to the virtues of different natural stimuli, and is as foreign from chemistry as any two subjects can be from each other (§ 136, 150–152, 188½, 442, 512 *b*, 535–568).

The whole philosophy, then, which concerns the greater tendency of animal than of vegetable food to promote the generation of heat, consists in the fact that animal is a greater stimulus than vegetable matter to the organic functions (§ 188½, 512 *b*). The fact is demonstrable, as I have said, while the food lies yet undigested upon the stomach of the famished wayfarer; and every one knows that his warmth will be thus instantly increased to a greater degree by cold

meat than by cold potatoes (§ 512, *b*). And so is it, to a greater extent, with the alcoholic liquors which the chemist assumes are burned in the recesses of the organization (nos. 7, 9).* The principle which concerns the whole is exactly the same as when warm water lights up a glow upon the surface, or determines perspiration, or an act of vomiting. Here, too, in all this development of heat, as in the other results, is involved a magnificent agency of the nervous system, but which to the chemist is impenetrable darkness (§ 350, no. 97, 500 *nn*, 512 *b*).—*See a curious contradiction about* ALCOHOL, p. 172, nos. 43, 94.

Those that have but imperfect views in physiology may comprehend the merits of this subject by considering the relative effects of animal and vegetable food in fevers and inflammations. An ounce of the mildest broth may raise the temperature many degrees, while a liberal supply of appropriate vegetable food would have no such influence; though a great exaltation of temperature would ensue upon solid vegetable food that should not undergo digestion. The reason of all this gives the right interpretation to the relative effects of animal and vegetable food in the generation of heat in ordinary states of the system, or till habit may interpose its influence. Irritability being in an exalted state in febrile affections is more than usually susceptible of the stimulus of animal food, and hence the increase of vascular action and the greater evolution of heat, both from the direct effect of the food and the exciting reflex nervous actions it occasions.

Where vegetable food remains undigested, in the foregoing case, it becomes a morbid irritant to the stomach, and the cause of reflex nervous influences that augment the fever or the inflammation, and thus engenders a rise of temperature (§ 137 *d*, 150–152, 222, &c., 512, &c.).

The same philosophy is applicable to differences in climate. Little vegetable food is consumed in the arctic regions, and, as little animal food should be eaten by man in the equatorial. Nature has ordained this allotment to men and animals, by a scanty vegetation at the north, while she appears to have limited her provision of animal food in tropical climates to the wants of the carnivorous race. To the north she has given beasts and birds, but with a stinted hand, and has been scarcely more liberal of the tenants of the deep. To the tropics a profusion of esculent roots, fruits, &c.; and has displayed a munificence in animal and vegetable creation throughout the vast temperate regions. This ordination of nature is particularly suited to the exigencies of the human constitution. Animal food is especially stimulating to all the functions of man, and therefore to that which generates heat. Irritability is greater, more susceptible to the action of stimuli, in equatorial than in other climates. The tropical heat is its measure of endurance; and when the stimulus of animal food is superadded, the tropical man is extremely prone to fever, and dies early. If wine, brandy, &c., be added also, so much the worse; but not because it is "burned" in the body (§ 188, &c., 615, &c., 618). Our author's philosophy, however, is too much of a curiosity to be neglected, and should have gone along with the pathological inductions (§ 350½). Thus:

"The Englishman in Jamaica sees with regret the disappearance of his appetite, previously a source of frequently-recurring enjoyment; and he succeeds, by the use of Cayenne pepper and the most powerful stimulants, in enabling himself to take as much food as he

* ALCOHOL appears to be in certain degrees digested, and in that state of transformation it undergoes absorption.—NOTE N p. 1121.

was accustomed to eat at home. But the whole of the carbon thus introduced into the system is not consumed. The temperature of the air is too high, and the oppressive heat does not allow him to increase the number of respirations by active exercise, and thus to proportion the waste to the amount of food taken. *Disease of some kind*, THEREFORE, *ensues.*"—*Animal Chemistry.*

Again, also, for a like physiological reason that animal food is too stimulating for man in tropical climates, vegetable is not sufficiently so for the obtuse irritability of the northern man (§ 191, 585, &c.); and it is therefore true in this acceptation that the arctic man would be more likely to freeze upon vegetable than animal food, despite of the superabundance of carbon in the former (§ 447, *h*). But, as I have said, and shown, he may, by the mere force of habit, come to endure the cold nearly as well upon vegetable as on animal diet (§ 442 *b*, 535, 1048).

I will also say, that it is a vulgar prejudice that "train oil and tallow candles" are appropriate food for man in any climate (§ 440 *b*, no. 9). The arctic, like every other man, would soon perish upon these indigestible substances. They would yield him neither flesh nor "fuel." And, having thus come again upon the philosophy of "fat" as a source of heat when taken into the stomach (§ 440, *bb*), the chemist is evidently embarrassed by the contrast which is presented by certain graminivorous and carnivorous animals (§ 440, *i*); and so he clears the way by the following assumptions, which have only reference, also, to a limited number of two genera of animals (§ 440, *cc*). The conclusion of the extract is a good specimen of our author's mode of disposing of former observation, and a profitable commentary upon what is requisite in "experimental philosophy" (§ 350, mottoes *a–e*, and no. 28). Thus:

"*We know*, in fact, that the graminivora expire a volume of carbonic acid equal to that of the oxygen inspired, while the carnivora, the only class of animals whose food contains fat, inspire more oxygen than is equal in volume to the carbonic acid expired. *Exact* experiments have shown, that in *many* cases only half the volume of oxygen is expired in the form of carbonic acid [350½ *n*, 440 *f*, nos. 17 and 18, 447½ *f*]. These observations cannot be gainsayed, and are far more convincing than those *arbitrary and artificially* produced phenomena, sometimes called experiments [by the "digestive mixture," retorts, acids, lamp-wick, &c.?]; experiments which, made, as too often they are, without regard to the necessary and *natural* conditions, possess no value, and may be entirely dispensed with; especially, when, as in the present case, *Nature affords the opportunity* for observation, and when WE make a rational use of that opportunity."

It remains only to say of the foregoing, that the chemist was not duly mindful of the fact that all the principal tenants of the deep, warm-blooded and cold-blooded, are alike carnivorous; and that the exalted temperature of the blubber-whale, the porpoise, &c., breathing, also, with lungs, and in their comparison with the low temperature of their associates that respire with gills, contrasts forcibly with those carnivorous animals whose respiration of oxygen is said to prevent an accumulation of fat. Such, I mean, is the fundamental doctrine of "fat" (§ 440 *bb*, no. 10). But since animal food, especially fat, contains more of the "fuel" than vegetable food, how does it hap-

pen, according to the foregoing statement as to the relative proportions of oxygen consumed and carbonic acid expired by the graminivorous and the carnivorous animal, respectively, that the former should surpass the latter in the formation of fat?

Wherever, therefore, we look at the "facts" of the organic chemist, we find ourselves not only in the midst of contradictions, but employed in refuting assumptions that are opposed by universal experience (§ 5¼). That experience I had employed in the *Commentaries* for the very purposes to which its adverse assumptions are now consecrated by the disciples of the "improved philosophy" (§ 349 *d*, 350¼).

441, *d*. In the case of the hibernating animals (§ 441, *c*), the excessive cold, and mechanical irritation, in rousing the calorific function, operate as a stimulus to the nervous system, and thus restore the organic functions, and the natural temperature as a consequence, along with the other organic products; though the heat more perfectly than any other. In a less degree, cold is a sedative to the hibernating animals (§ 188½, 743). This, also, is an example illustrative of the opposite influences of vital agents, according to their intensity of action, and the circumstances under which they are applied, and of the wonderful adaptation of the natural agents of life to the peculiarities of particular species of organic beings (§ 191, 446 *d*, 500 *o*).

The impression of cold, or mechanical irritation, in the foregoing case, is transmitted from the skin to the cerebro-spinal axis, where the nervous power is developed and radiated abroad upon the organic properties of the entire body, by which they are brought into operation (§ 222–233, 500, 512, &c., 638, 1044, *b*).

Respiration and other organic functions nearly cease during the state of torpor; but the restoration of heat is far more than commensurate with the progressive return of respiration. Of all the products, an evolution of heat takes the lead, as indispensable to the other important results. This appears to have been seen by Liebig. Nor is there any principle in physiology, nor any facts, which will at all explain the operation of cold in diminishing respiration, or circulation, till it has first reduced the temperature of the surface. And, were the chemical hypothesis true, the hibernating, and the young of other warm-blooded animals, should not sustain the remarkable reduction of heat which is produced by an atmospheric temperature of 45° F., since more oxygen is then consumed than at higher temperatures. There can be no such positive exceptions to a fundamental law. If peculiarity of constitution be assigned as the cause, then is the chemical hypothesis abandoned, and the vital theory admitted.

It is therefore apparent, that the reduction of temperature depends essentially on other causes than diminished respiration. The converse of this must be equally true; and when heat, therefore, is restored, the first step in the process is an increased action of the capillary blood-vessels, through the stimulus of the nervous power (§ 222, &c.), by which an evolution of heat is immediately started; and then begins an increase of the respiratory movements. "We can always hasten respiration," says Bichat, truly, "by making an animal suffer; but an acceleration of the pulse is always prior to that of respiration, which appears to be determined by it."—(See § 484, Exp. C.)

441, *e*. That is a test. If the heat rises without oxygen, it certainly does not, in such a case, depend upon combustion. The "carriers"

must be regularly supplied (§ 447½, *a*). I have said that Liebig appears to have been sensible that internal heat is important to the organic processes, though vastly more so in the warm-blooded than the cold-blooded race, and his statement upon this subject is one of his numerous contradictions of the hypothesis which he assumes. Thus:

"It is obvious that THE CAUSE OF THE GENERATION OF FORCE is diminished, because, with *the abstraction of heat*, the intensity of *the vital force diminishes.* It is also obvious, that the *momentum of force* in a living part *depends* on its proper temperature." "The increase of mass is effected in living parts by the *vital force.* The *manifestation* of this power is *dependent on heat;* that is, on a certain temperature peculiar to each specific organism." "The abstraction of heat must be viewed as quite equivalent to a diminution of vital energy." —LIEBIG'S *Animal Chemistry.*

Now, according to this reasoner, "in the animal body we recognize as the *ultimate cause of all force* only *one* cause, the *chemical action* which the elements of the food and the oxygen of the air mutually exercise on each other."

We are also told that "the mutual action between the elements of the food and the oxygen conveyed by the circulation of the blood to every part of the body is the *source of animal heat.*"—LIEBIG'S *Animal Chemistry.*

But, we have just seen that the same reasoner affirms that these very movements are "dependent on heat" (§ 350, no. 17½, &c.). The cause depends upon the effect, and the effect depends upon the cause (§ 440, *f*). And how could it be otherwise with an hypothesis so estranged from nature? Indeed, our author not unfrequently quits, entirely, the chemical ground of animal heat, as we have seen of many other assumptions (§ 350), and gives way to the simple dictates of nature. For example,

"Certain other constituents of the blood may give rise to the formation of CARBONIC ACID in the lungs. But, all this has NO CONNECTION with that VITAL PROCESS BY WHICH THE HEAT necessary for the support of life IS GENERATED in every part of the body."—LIEBIG'S *Animal Chemistry.*

And yet it is both a doctrine of this philosopher in physiology and medicine, that the evolution of animal heat is a purely chemical process, and that carbonic acid cannot be formed in the body without the disengagement of heat (§ 350, no. 17½; § 440, no. 17). Taking, also, in connection the two parts of the foregoing quotation, we have one of those palpable contradictions of a fundamental assumption which are the never-failing characteristic of false doctrines. There is the double affirmation that carbonic acid resulting from any other source than a vital process is not a cause of animal heat, and that animal heat is alone generated by a vital process. (See, particularly, § 440, nos. 6 and 16.) Or, allowing what the language does not admit, the dependence of animal heat upon carbonic acid "generated in every part of the body," we should then have the curious phenomenon in chemistry of the production in the animal body of carbonic acid by a chemical process and by a vital process, while that of the former, the very gist of the doctrine, does not, as avowed, contribute to animal heat (§ 1044).

441, *f.* Again, it is reiterated, that "the mutual action between the

elements of the food and *the oxygen conveyed by the circulation of the blood* to every part of the body is the source of animal heat" (§ 350, no. 3).

Now, frogs have a feeble power of generating heat, as have "all living creatures whose existence depends on the absorption of oxygen" (§ 443, *c*). But, these animals contradict our author's hypothesis as to the "carriers of oxygen," not only in its relation to animal heat, but other important matters, such as the production of *force*, of *motion*, &c. (see § 350, nos. 3, 4, 8). Spallanzani, for instance, deprived a number of frogs and toads of the heart, large blood-vessels, &c., and buried them in the snow, along with others which retained their circulation and vivacity. The whole soon became completely torpid, and "appeared as if frozen." In a few hours they were all removed to a warm situation, where all of them began to leap and make their escape; the reanimation being apparently as perfect in those which had been deprived of blood as in those which had not. When exposed to greater degrees of cold they perished in equal times (§ 441½ *d*, 443 *b*, 494).

How simple an experiment, therefore, may overthrow the most popular hypothesis in philosophy. It cannot be true of frogs that will leap and jump without blood, as well as frogs with blood, after being "apparently frozen," that their independent source of heat is owing to "the oxygen conveyed by the circulation of the blood," any more than their "*amount of motion* is proportional to the quantity of oxygen inspired and consumed in a given time by the animal" (§ 350, no. 8). And then, too, according to our author,

"Since physiology has proved that the globules of blood take no share in the process of *nutrition*, *it cannot be doubted* that they play a part in the process of *respiration*." Especially in white-blooded animals.—Liebig's *Animal Chemistry*.

From all which it is more and more apparent, that "the Reformer" was employed about a plan of human chemistry rather than of animal chemistry (§ 440, *c*).

The foregoing subject is farther continued in § 443–445.

441½, *a*. What has been said in the preceding section of the hibernating and cold-blooded animals is true, in principle, of all other animals who suffer only a partial reduction of temperature. The differences do not arise from different fundamental laws, but from different modifications of the properties of life in different species of animals, and at different ages of the same individual (§ 155, 185, 191). There are many animals that approximate the hibernating in their feeble power of maintaining heat; and others, again, which sustain intermediate relations to the more perfect of the warm-blooded vertebrata. "The high temperature," says Edwards, in his *Influence of Physical Agents on Life*, "which seems to characterize the mammalia and birds, does not belong to them exclusively, since examples of it are found among insects; and, on the other hand, among the mammalia themselves (as the hibernating), which, at certain periods, present the principal phenomena of the cold-blooded vertebrata; and, lastly, a great number of non-hibernating mammalia and birds, in the early periods of their life, show, as far as the phenomena of heat are concerned, a strong resemblance to the cold-blooded animals."

It may be thence inferred, that what is so remarkably conspicuous

in the torpid hibernating animals is only the result of a law that prevails throughout the animal kingdom. This law extends equally to the vegetable kingdom, which possesses a far greater power of generating heat than frogs and other cold-blooded animals. The trees and shrubs which belong to northern climates have, also, exactly the peculiarity of the hibernating animals, while those of tropical regions maintain a greater uniformity of temperature, and are destroyed by a degree of cold in which some northern herbaceous plants spring into active life, and pierce their way through snow and ice.

441½, *b*. And this leads me to say, that, through the same law, the warm-blooded vertebrata have their standard of heat modified by climate; and even man himself sustains variations of 1° to 2° F. And, as I have said in my former Essay on *Animal Heat*, it is important to remark, as showing the entire independence of this phenomenon of respiration, this change does not take place till such as remove from one climate to another shall have been for some time subjected to the new condition of vital stimuli. It is the result of acclimation, and, trivial as it may seem, it is full of the most instructive illustration to a reflecting mind. The phenomenon, I say, is owing to permanent modifications of the vital constitution, and is of the same nature as the change of temperament which the melancholic undergoes on passing from the temperate to the equatorial regions (§ 602), and about which the law of vital habit is interested (§ 561, 585, 602, 603, 1047).

441½, *c*. It is equally a fatal circumstance to the chemical hypothesis, that the standard of heat is lowest in cold, and highest in hot climates, whatever the amount of clothing, &c., since more oxygen is respired in the former, and, according to our author, a far greater quantity of "fuel" is consumed both by the mouth and by oxygen gas (§ 440, nos. 8, 9, &c.). It is not difficult, therefore, to understand the bearing of the following statement:

"The most trustworthy observations prove that in all climates, in the temperate zones as well as at the equator or the poles, the temperature of the body in man, and in what are commonly called warm-blooded animals, *is invariably the same.*"—LIEBIG'S *Animal Chemistry*.

And why, again, is the temperature of man higher in tropical than in temperate climates? The reply is another proof of the tampering of chemistry with a subject utterly beyond its reach; since the heat of the tropics operates gradually as a vital stimulus to the calorific function, and thus slowly establishes that condition by which an exalted temperature is determined throughout the universal body (§ 350, no. 65, 441 *c*, 445 *e*).

441½, *d*. Nor may I neglect the striking characteristic of the egg, which possesses the power of resisting cold "in a degree equal to that of many of the inferior animals." This is one of the facts which led Mr. Hunter to believe that the vital properties are capable of generating heat independently even of circulation (§ 441, *f*), while its greater evolution is seen to be the result of those properties in active operation through the mature organization (§ 65). The former condition, associated, also, with the power of resisting the causes of putrefaction, is a beautiful illustration of the nature of life, that it is an active, not a passive state, that it consists essentially of power, and that its laws are specific. But, how will the combustion hypothesis dispose of the internal source of heat in the egg?

442, *a*. In respect to the affirmation that "clothing is merely an equivalent for a certain amount of food" (§ 440, no. 11), I have adduced, in my former Essay, many facts to prove that our clothing is greatly a matter of habit, and this is shown by the facts which will be soon presented. It is, indeed, a forcible illustration of the nature of the properties of life, of the dependence of animal heat upon vital action, and of its obedience to the law of vital habit, and to the constitutional law by which all results shall be so regulated as to maintain the integrity of organic processes, and, therefore, a uniform temperature of non-hibernating warm-blooded vertebrata; while, as I have endeavored to show in the same work, the modifications of these processes in hibernating and cold-blooded animals, as well as in the vegetable kingdom, are not only perfectly consistent with what is observed of the non-hibernating warm-blooded vertebrata, but go to confirm the whole philosophy which is founded upon the phenomena of these animals.

There, too, I have shown by an examination of facts, that the rapid change in the power of elaborating heat in early life depends on the same common principle which determines the changes in all other functions and results, that they are all on a par in principle, and that the rapid increase of the resistance of cold in the young of the warm-blooded vertebrata proves the vital character of the calorific function (§ 153–159, 441 *b*, 1047, 1048).

442, *b*. In illustration of the law of vital habit as it respects the power enjoyed by man of resisting cold (§ 441, *c*), and in farther disproof of the assumption that a living animal is "like any other heated mass in relation to the temperature of surrounding objects," I shall quote from the *Commentaries* one of the facts which are there presented for the purpose which is now in view. Thus:

"Mackenzie says, that some of the northern savages follow the chase in the coldest weather with only a slight covering. Lewis and Clark state, that two Indians slept upon the snow during the night in a light dress, when the thermometer was 40 degrees below the zero of Fahrenheit. The man was uninjured; the boy had his feet frozen. Now it is evident that no civilized man could sustain such an exposure. The phenomenon is owing to *the power of habit* in relation to the forces of life, and is utterly insusceptible of explanation on any other principle."—*Commentaries.*—See § 1047, 1048.

On the other hand, an individual froze to death in the woods of Peacham, Vermont, on the night of the 7th of June, 1817; notwithstanding, also, he was full, to intoxication, of the most combustible substance (§ 440, no. 9).

But, again, we are informed by Captain Wilkes, that, when the thermometer was at 40° F., "the Petcherai Indians were entirely naked, with the exception of a small piece of seal-skin, only sufficient to cover one shoulder, and which is generally worn on the side from which the wind blows, affording them little shelter against its piercing influence."

Again, says Captain Wilkes, "On the 11th of March, three bark canoes arrived, containing four men, four women, and a girl about sixteen years of age, four little boys, and *four infants*, one of the latter about a week old, and quite naked. The thermometer was at 46°

Fh."—WILKES's *Narrative of the United States Exploring Expedition*, vol. i., p. 121, 124. 1845.

The foregoing, in relation to the *infants*, should be considered in connection with what has been ascertained by Dr. Edwards as to the comparative inability of infants to bear a cold atmosphere, when unaccustomed, and with what is known of hereditary constitution (§ 447 *h*, 540, 561. See, also, *Medical and Physiological Commentaries*, vol. ii., p. 27, 52, 56, 69–74).

"The power of the Russian Zincali of resisting cold," says Barrow, "is truly wonderful, as it is not uncommon to find them encamped in the midst of snow, in slight canvas tents, when the temperature is 30° or 40° below the zero of Fahrenheit."—BARROW's *Zincali of Spain*.

No two individuals under apparently equal circumstances, of the same health, age, sex, and with the same quantities and qualities of food, clothing, &c., are alike in the power of resisting cold. Place them in a temperature at zero of Fahrenheit, and one will perish while the other will not suffer. One shall enjoy a glow of warmth from athletic exercise, while the other shall perish with the same counteracting means. It is a common event to witness the blasters, in the vicinity of New York, at work in winter with heavy drills in their naked hands, while others, unaccustomed, would be frost-bitten at the same temperature. The difference is manifestly owing in part to a difference in constitution, but especially to the influence of *habit*, which engenders the power of enduring intense degrees of cold, and which no chemical principles can possibly expound (§ 535–568, 1047).

442, *c*. The foregoing facts show us, also, how it has happened that animals have spread abroad from the spot where they were created, and become specifically adapted to different climates. The element of their adaptation was implanted in their vital constitution at the time of their creation, and relates to almost all physical agents. And so with vegetables, which may be gradually transplanted from the equator to high northern latitudes, where they also undergo changes of organization (§ 155, 535, 538, &c.). Thus do we also again bring the philosophy of physiology to the overthrow of that infidelity which departs from the Mosaic account of organic Creation (§ 74, 350¾, *h–n*).

442, *d*. Again, do the beasts or the birds of the polar clime change their fur or their plumage when transported to a temperate region? What, for example, answers the white bear, with which we are all familiar? And yet their temperature sustains but a slight change, though a change subversive of the combustion theory (§ 441 *c*, 441½). Here, too, in truth, they consume a far greater quantity of food; and, if the chemist's hypothesis as to an interchange of caloric with the atmospheric air be adopted (§ 440, no. 14), these transplanted creatures should sustain a very exalted rise of temperature. But, upon the physiological action of external heat, as a vital stimulus, the high temperature of a warm climate would much more than compensate for any supposed deficiency of oxygen (§ 440 *e*, 441½ *c*, 1047).

"And then, on the other hand," turning again to man, and as I have said in the Commentaries, "are the experiments of individuals subjecting themselves to an excessively high temperature without sustaining any sensible variation of heat. This was fully demonstrated by Blagden, Banks, Fordyce, Solander, G. Home, Dundas, Dr. North, Phipps, Seaforth, and Dobson, who exposed themselves to 260° F."*

* Cl. Bernard's late Experiments of this nature upon animals do not affect these facts or the philosophy. They were like those of graduated poisons.—1860.

442, *e*. We see, then, in the various demonstrations, which have now been made, of the power of all warm-blooded, non-hibernating vertebrata to maintain a uniform degree of heat under the greatest vicissitudes of atmospheric temperature that are compatible with life, a proof of a most astonishing law of the living body, in perfect conflict with the laws of caloric as they exist in the inorganic world. "We know it" as exactly as we comprehend the nature and operation of the most precise law in physics. It is, in itself, demonstrative of the government of living beings by specific forces. It establishes a positive distinction between these forces and the organized structure. If I am not right in this construction, I say, once more, let the ground of objection be shown. I mean not the usual denial, or by renewed misrepresentations of my statements. The objections must be founded upon a broad and philosophical survey of all the phenomena of heat that relate to living objects as they may be modified by natural causes, or by morbid states of the system; and the ground must cover the general physiological condition of organized beings. How wide from all this are the assumptions, and those mostly relative to man (§ 440, *c*), that have been lately consecrated as the true "experimental philosophy" of animal heat (§ 349 *d*, 1047)!

443, *a*. As my former Essay embraces an extensive range of inquiry into the facts and philosophy attending the calorific function in the cold-blooded race, I shall now add only a few remarks to what I have already stated upon this subject, and as suggested by the present stage of my inquiry (§ 441 *f*, 441½ *a*).

443, *b*. Frogs and other cold-blooded animals are supplied with capacious lungs; and, however it may be argued that their consumption of oxygen is less than that of warm-blooded animals, they have, nevertheless, the same respiration, nutrition, vital decomposition, and the same "charcoal fire," in the ratio of the food consumed, and yet is their temperature principally regulated by that of the surrounding medium. They also emit a large amount of carbonic acid, which proves a free consumption of oxygen and a liberal supply of food. All this is as essential to frogs as to man; and they equally perish when deprived of atmospheric air, and so of all the cold-blooded finny tribe (§ 350, no. 17½, and § 440, no. 10). And what will chemistry answer to the exalted temperature which attends the inflammations of the cold-blooded vertebrata?

Chemistry must here be consistent, and in being so it necessarily abandons the hypothesis that the evolution of heat, in warm-blooded animals, depends on the union of oxygen with the carbon and hydrogen of the body, and that it occurs in the ratio of that combination. "*In the animal body*," says Liebig, "*the food is the fuel; with a proper supply of oxygen we obtain the heat given out during its combustion.*" (Also, § 440, nos. 5, 6, 17.)

443, *c*. The difference in the law regulating temperature is owing to a difference in vital constitution, of which the chemist takes no account (§ 440, no. 12). But, there are also many other peculiarities in the vital phenomena of cold and warm-blooded animals which are due to the same condition of constitution, and by which their relative power of generating heat is shown to depend on a common cause, and which is common to all the phenomena. It is this which renders cold-blooded animals greatly subject to the temperature of the

surrounding medium, but which also enables them to resist its influence by some 2 or 3 degrees at all seasons of the year.

443, *d*. If the chemist resort to difference of constitution in explaining the foregoing phenomena, as is generally done, he resorts to the properties and functions of life, and abandons his own ground. In one case he says, it is because they are cold-blooded, and in the other, because they are warm-blooded, and so on. Such, indeed, is the fact. But, is it not because the organization and vital endowments are not adapted to the same generation of heat in one case as prevails in the other; and this, too, when the organization may be in a high degree simple (§ 409, *e*)?

444. Let us, therefore, settle this question by reference to an animal without lungs, or gills, and in which, also, the temperature is clearly influenced by causes which can alone operate as vital stimuli. The temperature, for example, of a hive of bees is at about 90° F., when the air is at 40°, and upward of 70° in winter. Their power of generating heat is also increased during the breeding season. This phenomenon corresponds with the observations that I have made upon vegetables; having found the temperature highest when the leaves and blossoms are putting forth.—(*Medical and Physiological Commentaries*, vol. ii., p. 75–78.)

445, *a*. Still more conclusively, than the obvious dependence of organic heat in the cold-blooded vertebrata, insects, &c., upon vital principles, do the phenomena of vegetable heat evince the same great law of organic nature. This subject has been ably explored by John Hunter, and, as I have intimated in the foregoing section, has received a careful attention from myself. Senebier, also, saw the thermometer rise from 79° to 143° F., when placed in the midst of a dozen spathes of the *arum cordifolium*, at the time of opening their sheaths. And so Huber, and others.

445, *b*. That fact, and the ability of plants to generate a temperature often far above the earth or the surrounding atmosphere, are so apparent that they are universally admitted; but obtain from the chemist no farther notice. Indeed, the following is all that we have from Liebig on the subject of vegetable heat. Thus:

"All living creatures, whose existence depends on the absorption of oxygen, possess within themselves a source of heat independent of surrounding objects. This truth applies to all animals, *and extends, besides, to the germination of seeds, to the flowering of plants, and to the maturation of fruits.*"—*Animal Chemistry.*

And yet is the "combustive process" always in progress, more or less, in all parts of vegetable organization. The question, therefore, arises as to the motive for not only concealing an important fact, but in thus implying, by circumstantial statements, that no other parts of vegetables "possess within themselves a source of independent heat." The very fact that such a source belongs to seeds in their germinating state, &c., is sufficiently conclusive that it extends to every part of the plant, and "the Reformer" could not have been ignorant that the very egg resists a temperature below the freezing point in virtue of its internal source of independent heat.

But, all this is fatal to our author's hypothesis. Eggs do not consume oxygen, have no "carriers of oxygen," and trees, it is said, do not "burn" like the animal body (§ 302, 303$\frac{2}{3}$). Consequently, the

chemist, to carry out his hypothesis of animal heat, must maintain the anomaly that seeds, flowers, and fruits, during their development, are the only parts of the vegetable world that possess "an independent source of heat." The secret of all this will be farther seen in the following passage:

445, *d.* "The distinguishing character of vegetable life is a continued passage of matter from the state of motion to that of static equilibrium. A plant produces within itself *no cause of motion*" (see § 350, nos. 7, 8, 10, and § 440, nos. 5, 6, 8, 9, 12, &c.). "In a word, no waste occurs in vegetables. [?] Waste, in the animal body, is a change in the state or in the composition of some of its parts, and consequently is the result of chemical action." — LIEBIG'S *Animal Chemistry.*

And, again: "Analogy, that fertile source of error, has unfortunately led to the very unapt comparison of the vital functions of plants with those of animals."—LIEBIG'S *Organic Chemistry*, &c.

445, *e.* Thus is the problem solved. There is either no heat generated by plants, or, otherwise, the chemical doctrine of animal heat is radically false. To show how this may be I shall now introduce an abstract of some observations made by myself on the temperature of trees. It is unnecessary to state the mode in which the observations were conducted, or the precautions adopted, as they are recorded in the *Commentaries.*

On the 9th of April, 1839, in a neighboring forest, the following results were obtained:

Range of the thermometer in the shade during the observations, which lasted six hours, from 38° to 52° F. Near freezing at sunrise.

A dead upright tree was selected as a standard of comparison. Its diameter was 12 inches. The temperature of this tree, at the close of my observations, was 45° at the centre and in all other parts (§ 440, nos. 14, 15, and 16).

Juglans squamosa,	diameter 10 inches,	48°	Buds slightly enlarging.
Do. do.	" 6 "	49°	do.
Fagus sylvatica,	" 10 "	49°	Buds swelling.
Quercus tinctoria,	" 7 "	49°	No budding.
Castanea Americana,	" 12 "	50	do.
Betula nigra,	" 4 "	51°	Flowering.
Salix Babylonica,	" 18 "	53	Buds unfolded.
Do. do.	" 18 "	53°	do.
Pinus Canadensis,	" 18 "	54°	
Platanus occidentalis,	" 18 "	50°	No budding.
Do. do.	" 6 "	54°	do.
Do. do.	" 4 "	55°	do.
Juniperus Virginiana,	" 4 "	55°	
Robina pseudacacia,	" 3 "	62°	do.
Populus lævigata,	" 4 "	62°	In bloom.
Do. do.	" 4 "	64°	do.
Do. do.	" 3 "	63°	do.
Do. do.	" 3 "	65°	do.
Do. do.	" 2 "	67°	do.
Do. do.	" 1¾ "	68°	do.

Believing that if the vital doctrine of the generation of animal heat were correct, I should find an elevation of vegetable heat as the warmth of the season increased, and the energy of vegetable life became more exalted, on the 19th of the same April I made another visit (§ 441½, *c*).

Range of the thermometer in the shade during the observations, which lasted five hours, from 40° to 65°.

Temperature of two dead, dry, upright birch trees, one eight inches in diameter, the other six inches, at end of observation 60° in all their parts. Temperature of the earth six inches below surface 47° in shade, at close of observation. Probably 50° at two feet.

Betula nigra,	diameter 15	inches,	54°	Buds swelling.
Platanus occidentalis,	" 6	"	59°	do.
Quercus virens,	" 8	"	62°	do.
Do. do.	" 2½	"	73°	Buds much more advanced
Do. tinctoria,	" 18	"	65°	Buds swelling.
Do. do.	" 6	"	66°	do.
Juniperus Virginiana,	" 5	"	64°	
Do. do.	" 2	"	79°	
Acer rubrum,	" 12	"	65°	In bloom.
Castanea Americana,	" 4	"	66°	Buds swelling.
Cornus Florida,	" 2	"	68°	Flower-buds advancing; no leaves.
Fagus sylvatica,	" 12	"	68°	Buds opening.
Juglans alba	" 4	"	75°	Buds swelling.
Do. do.	" 1	"	83°	Buds larger.
Do. do.	" ¾	"	82°	Buds opening.

445, *f*. It is abundantly manifest from the foregoing observations that vegetables possess a vital power of generating heat, according to the activity of their organic forces; and I carry the analogy to the animal kingdom. The temperature was not influenced by that of the earth, as seen by the preceding statement. The heat of the latter, however, was not ascertained at the first observation. It appears, also, that the power of generating heat is greater in proportion to the youth of trees. This remarkable fact is not only especially indicative of the vital agencies in the generation of vegetable heat, but is worthy of notice on account of its opposition to what obtains in the animal kingdom in respect to age. It corresponds, also, with observations upon herbaceous plants. The difference depends upon the relative difference in organization and vital properties at the corresponding periods of life. —*Comm.* Also, § 153–155, 441 *b–i*, 1054.

445, *g*. It is a fundamental principle, therefore, that "*the general phenomena of the disengagement of heat remain always the same in animals with lungs, in those without them, and in plants, all of which have an independent temperature.*"—BICHAT.

446, *a*. The relation of the nervous power to animal heat is the same as that of all other products of animal organization; its influence, however, being sometimes remarkably pronounced in the elaboration of heat, as seen in the quick transition of the hibernating animal from temperatures below 40° to upward of 90° F. This subject, however, has been so extensively investigated in my former work that I shall only say now that the elaboration of animal heat does not depend on the nervous power, as often maintained, but, like other functions of animals, is only influenced by it (§ 183–185, 188, 222–233, 489, 492, 500). These are variously affected by varying influences exerted upon the cerebro-spinal and ganglionic systems, as, of course, are also the secreted products in a corresponding manner. In the perfectly natural state, the nervous system has no important agency in the production of the phenomena, but may become powerfully instrumental in modifying the properties, and actions, and products of life, when unusual conditions exist, or when unusual impressions are transmitted to the cerebral and sympathetic centers. Analogy, also, as supplied by the vegetable kingdom, affords the strongest presumptive evidence that the nervous system may have no active participation in the elab-

oration of heat, in the natural condition of the body, while this induction is strengthened by what is known of other secreted products in both of the animated kingdoms. Still, in respect to the animal kingdom, the mere existence of the cerebral and ganglionic systems, their remarkable properties and susceptibilities, and their intimate connection with all parts of the organization, is, *prima facie*, conclusive that they have important offices in relation to animals, and that their presence, in the natural state of the complex being, is indispensable to the integrity of every function. This, as will have been seen, has been experimentally ascertained in relation to many; and that unusual, or sudden impressions that are not unnatural, as the operation of the passions, for instance, may be extensively and profoundly propagated from the brain to other organs. It has been fully demonstrated that the natural condition of the secretions depends upon the integrity of the nervous connection between the secerning organs and the cerebro-spinal axis; while it has been equally shown that the organic functions, and all vascular action, may be immediately and powerfully influenced by impressions made upon the brain and spinal cord, whether in a direct manner, as in Philip's Experiments, or indirectly through reflex nervous action, as in blows upon the stomach, surgical operations, the action of medicines and of poisons upon the intestinal canal, &c., the ganglionic nerve being the principal medium.

Assuming, then, that animal heat is also a secreted product, it would come philosophically under the common law; and since it appears from experiment, that animal heat depends even more upon the presence of the brain than an imperfect production of gastric juice and other secreted fluids, and may be as powerfully influenced through the nervous system, the physiological analogy between heat and other secreted matters becomes quite apparent; while it explains the remarkable effect of a low atmospheric temperature in developing heat in the torpid hibernating animal (§ 441, 441½ *a*); and thus conducts us, also, to the philosophy of the operation of other causes in modifying animal temperature (§ 461, 1032 *d*, 1044).

To maintain the foregoing conclusion, I have examined, in my former Essay, the merits of Brodie's, Philip's, Chaussat's, and other experiments upon the nervous system, the phenomena of hibernating animals, the modifications of temperature that spring from injuries, diseases, and other affections of the nerves, &c., the admissions of distinguished chemico-physiologists, and other important considerations. Some of these facts in relation to the nervous influence upon animal temperature will appear in the next following section.

446, *b*. It should be said, however, that it has been stated by some that the experiments of Philip conflict with those of Brodie and Chaussat, which establish an influence of the nervous power over the phenomena of animal heat. But that is an error; since the deduction of Philip himself from his own observations ascribes to the nervous power what is due to the organic power. Thus:

"That the maintenance of animal temperature is a function of the nervous system, properly so called, appears from a variety of facts generally known; the temperature either of a part or of the whole body being lessened by any cause that impairs the action of particular nerves in the former instance, or of the whole nervous system in the latter."—PHILIP, *on Acute and Chronic Diseases*, p. 48.

Again he says, "I here consider it as proved, by experiments already laid before the reader, that the evolution of caloric is a function of the nervous influence."—PHILIP's *Inquiry into the Laws of the Vital Functions, Exp.* 77. (Also, § 437, *c*, NOTE AA p. 1131.)

446, *c*. It is, of course, erroneously stated by "the Reformer," that, "by the division of the pneumogastric nerves, the motion of the stomach and the secretion of the gastric juice are arrested." The juice is only modified in quality, while it is actually increased in quantity (§ 461, 489).

"The Reformer" has also high conceptions of the agency of the nervous system in organic results, notwithstanding they are all exclusively due, in his estimation, to the merest chemical processes (§ 350). "Every thing in the animal organism," he says, "to which the name of *motion* can be applied, proceeds from the nervous apparatus." Our author, however, is entirely mistaken in his opinion that "*the singular idea* that the nerves produce animal heat has obviously arisen from the notion that the inspired oxygen combines with carbon in the blood itself." Nevertheless, we are told by our author that "*every thing in the animal organism* to which the *name of motion can be applied proceeds from the nervous apparatus;*" and we are also told that without this motion there can be no animal heat (§ 350, nos. 3, 17½, 6, 7, 18½, 19).

But, take the ordinary construction of those who mingle together but virtually contradistinguish, the powers and processes of living and dead matter, and impute to the nervous influence no small share, along with chemical agencies, in the production of heat and other products of the living organism, we are asked to sanction one of the most unphilosophical and incongruous medleys of powers, processes, laws, and principles, acting and reacting upon each other, that ever presented itself for well-merited satire. The nervous power is also apt to be regarded by the chemico-vitalist, as by the chemist, a mere chemical agent. But, we shall have seen that this construction is encumbered with difficulties (§ 222, &c., 451 *f*, 500 *nn*, 638½).

446, *d*. The modifying influence of the nervous system upon the generation of animal heat being established not only by experiments, but especially, also, by facts relating to morbid states of the system, to which I shall soon advert, and by all that is philosophical in physiological science, and when we consider, also, how easily and rapidly the nervous influence may be determined upon the vascular system (as in blushing), and upon the organic viscera, we have an intelligible explanation of the operation of a very low degree of cold in recalling into action those vessels upon which depends the exaltation of temperature in the torpid hibernating animal (§ 441 *d*, 441½ *a*). That the intensity of the cold, like the mechanical irritant (§ 441, *c*, *d*), operates, also, in a direct manner, upon the *organic* properties, as in other instances of foreign agents, is undoubtedly true (§ 189). The law being also universal explains the influences of other causes, in health and disease, in modifying animal temperature, and only regards the agency of *respiration*, like that of digestion, &c., as being instrumental in perfecting the blood, and thus adapting it to the uses of the various organs which are concerned in the elaboration of heat and other products.

447. *a*. Whatever is true, in a fundamental sense, of the production

of heat in the natural state of the organic being, must be equally so in its morbid conditions. It is true, we are told by "the Reformer," that "*we cannot investigate the laws of life in an organized being which is diseased;*" but we have seen that this will not hold in experience or philosophy (§ 303¾). It serves, however, its useful purpose in the chemical doctrine of animal heat. But, since the truth is just the reverse (§ 160, 163), I shall present from the *Commentaries*, in this section, a series of facts which contribute an important light upon the physiology of calorification, and upon the general constitution of organic beings. We shall learn yet farther, by this demonstration, that the evolution of animal heat is exactly on a par with all other secreted products, and has a corresponding dependence upon decarbonized blood, and can be regarded in no other aspect (§ 764, *c*). And here our author's philosophy is consistent, since he imputes alike the formation of animal heat, and all other products, even the circulation of the blood, nay, all diseases, yea, death itself (§ 350, no. 46), to the union of oxygen gas with the elements of food.—NOTE DDD p. 1149.

447, *b*. Indeed, it cannot be too often said, as shown by the question before us, that the phenomena supplied by diseased conditions are often the most important in illustrating the properties and laws of organic beings; and upon no question have they a greater bearing than the one under consideration. Morbid states are only physiological changes, and the resulting products and phenomena are simply modified conditions of such as are more natural, and are dependent upon the same laws, the same causes, the same functions as determine the healthy results (§ 155, 156). This is an undeniable proposition. In the conflict of doctrines, therefore, which are predicated of the perfectly natural phenomena, we should seek for the light of such as emanate from diseased conditions; and here the chemist is even more disqualified for investigation than in the dark mazes of physiology. To him, the vast field of pathology, which every where stamps with falsehood his chemical views of life, is as hidden as undiscovered regions; and since all pathological and therapeutical conclusions necessarily refer to the natural physiological conditions, their impracticability, absurdity, and destructiveness, when deduced from the chemical premises, as clearly demonstrate the shallowness of their foundation. The student of organic nature, therefore, appreciates, as he deplores, the ignorance which is received as the light of knowledge (§ 349, *d*).

447, *c*. It should be considered, also, in respect to the vast differences in temperature that spring from morbid conditions, whether high or low, the diet is often the same, very spare, or when the temperature is most exalted, as in active forms of fever and inflammation, there is a total abstinence from food. Consider, also, the brute animal under the same circumstances, abstaining totally, yet suffering a very exalted temperature (§ 440, nos. 1, 4, 5).

I shall proceed, therefore, to a statement of some of the important facts which are supplied by disease, as set forth in my former Essay on Animal Heat. For the authorities quoted, see the Essay.

447, *d*. Diseases of the brain supply a variety of facts which illustrate our inquiry. Thus, in phrenitis, one arm, or one side of the body, is colder than the other. "That the temperature of a paralyzed part is generally below the normal standard is now universally admit-

ted." That this is owing to impaired vitality, is also shown by the frequent failure of nutrition in the paralyzed part, as well as other coincident phenomena. In a case related by Mr. Earle, he found the temperature at 70° F., in the hand of a paralyzed arm, while that of the opposite hand was 92°. He could also effect a temporary restoration of temperature by electricity and by blisters. "The circulation of the blood did not appear to have suffered, the pulse at the wrist being synchronous, and equally strong with that of the other limb." In an injury of the sympathetic nerve, Chaussat saw the temperature fall from 104·88° to 78·8° F., in ten hours.

On the other hand, there is a remarkable exaltation of temperature in a part at the invasion of *tic douloureux*. So, when the nerves are mechanically injured. There was a patient at St. George's Hospital, whose temperature rose 11° F., in consequence of an injury of the spinal column; and this took place when the respirations did not exceed *five or six in a minute*. It is stated by Dr. Macartney and other observers, that when the principal nerve of an extremity is divided, the temperature of the limb is immediately exalted several degrees. The philosophy of this is well expounded by an advocate of the chemical doctrine. "We should be disposed," he says, "to regard it as due to the temporary excitement of the molecular changes by the irritation produced by the section of the nerve, and propagated to its extremities." Now apply this language to the exaltation of temperature in any inanimate substance, however produced, and we may appreciate the merits of the chemical solution in the former instance.

"In some subjects of insanity," says Dr. Cox, of Fish Ponds, "who were under strong coercion in the horizontal position, with the head much elevated, whose face was red, and the vessels turgid, the difference of heat was very obvious, varying 10, 12, and even 15 degrees."

In apoplexy, the temperature has been known to rise, after death, a number of degrees above the natural standard; and its persistence has been found so uniform in apoplexy, that Dr. Cheyne regards it as a diagnostic symptom. The temperature of a lawyer, dead of apoplexy, was so high at twenty-four hours after death, that Portal delayed an examination of the body. The same phenomenon is observed after death from other diseases,—especially when the nervous system has been unusually concerned in the morbid process.

"In opening bodies at the Hôtel Dieu," says Bichat, "I have observed that the time in which they lost their animal heat was very variable; that a body continues warm a greater or less time, especially among those who have died suddenly of an acute affection, in the paroxysm of an ataxic fever, for example, or by a fall; for those who die of a chronic disease, lose almost immediately their caloric. The difference in the first is often three, four, or even six hours. This phenomenon arises from the fact, that whenever death is sudden, it interrupts only the great functions; the tonic action of the parts continues for a greater or less time after. Now this action disengages a little caloric from the blood that is in the general system." "When the disengagement of caloric has ceased in the body, that which remains in it becomes in equilibrium with that of the external air, according to the general laws of this equilibrium. Now these laws being uniform, their effect would be the same in every case."

Again, sometimes the temperature in apoplexy is greatly depressed

before death takes place; and this, too, while the circulation is such as to admit of blood-letting. Two cases of violent apoplexy ("violento paroxysmo") are recorded in the Ephemerides Germanii, in which the blood, as it flowed from the veins, was actually cold. Morgagni mentions an instance of another affection in which the blood flowed "in an icy cold stream" from the arm. Thackrah saw a similar phenomenon. So, also, De Haën. I need scarcely say, also, that when respiration is extremely labored and slow in apoplexy, the natural temperature is often either undiminished or considerably exalted. Our familiarity with the fact, however, only increases its importance, and shows, by the frequency of the coincidence, that respiration can be only remotely concerned with the generation of heat.

Here is another variety in apoplectic affections:

"While a gentleman," says Mr. Hunter, "who was seized with an apoplectic fit, lay insensible in bed, covered with blankets, I found that his whole body would, *in an instant*, become extremely cold in every part, continuing so for some time; and as suddenly would become extremely hot. While this was going on alternately, there was no sensible alteration in his pulse for several hours."

Here is another case, from the same observer, not less fatal to the theory of respiration:

"A man fell from his horse, and pitched on his head, and produced all the symptoms of a violent injury. There was concussion, and perhaps extravasation of blood. The pulse was at first 120, but came to 100, and sometimes to 90, and was strong, full, and rather hard. He was *very hot* in the skin, but *breathed remarkably* slow, only half the common frequency." Other injuries exalt the temperature in other modes of an equally vital nature. Thus, extirpation of the kidneys through the increased stimulus of the blood, often raises the temperature of the body more than six degrees.

The following case, by Mr. Hunter, also, seems also to have been intended for our special purpose:

"February, 1781, a boy, about three years old, appeared not quite so well as common, being attacked with a kind of shortness of breathing in the night. It had become excessively oppressive about five o'clock on Sunday morning, so difficult that he appeared dying for want of breath. The common rate of breathing in such a boy is about thirty inspirations in a minute. At 10 o'clock, he was drawing his breath with a jerk,—about *two and a half inspirations*, or even less, in a minute. Pulse sixty, *faint*, slow. On tying up the arm, the vein did not appear to rise in the least, so that the *blood did not go its round*. Body *purplish*, especially the lips. He had a *fine warmth* on the skin *all over the body*, although in a room *without a fire*,—not covered with more clothes than common in the month of February, with snow falling at noon."—HUNTER.

This, and the preceding case, appear to differ in some physiological details. In the former, the disposition of the capillaries to generate heat seems to have been a good deal determined by the cerebral influence; in the latter, the alteration of the vital forces was probably owing to other causes. Like other cases, therefore, which I have recited, they serve, by their variety, to illustrate the vital nature of the principles which are mainly concerned in the production of animal heat. But, standing alone, they must either subvert the hypothesis

which concerns respiration, or we must have a chemical theory for the natural state of the body, and a vital one for its morbid conditions. This would be clearly absurd; at least, if there be any such thing as philosophy, or any consistency in the powers and functions of life. These examples show us, also, how very probable it is, that all our chemical hypotheses in relation to life are the mere offspring of habit, or imitation, or of narrow observation. It is certainly hard to give up the fruit of great toil and research; but it is harder for others to endure it, who prefer to be instructed by the voice of nature, rather than by artificial results.*

I shall present other examples to the foregoing effect, as supplied by morbid conditions of the system; since these, more than experiments, conduct us to the true philosophy of animal heat.

Every physician is familiar with the variations of temperature in disease; which, indeed, engage his attention in almost every case. It is often exalted when respiration is slow, and again depressed when breathing is hurried; and it is one of the most common phenomena to find it different, by many degrees, in different parts of the body, and under every variety of respiration and circulation. It will, therefore, be my purpose only to mention a few of the more unusual instances.

Dr. Philip has known the temperature of the skin at 74° Fh. in the cold stage of an intermittent, while in the hot stage it rose to 105°. Craigie found it at 107°, and 109°. Here the respiration and circulation are often most accelerated during the cold stage. This, with the vast difference in temperature, refers the depression of heat to other causes than the mere constriction of the capillaries in the cold stage. Here, too, as in all analogous cases, we have a coincident diminution of all other secretions. Piorry has seen the temperature in six cases of typhoid fever varying from 108° to 117°; and in one of these, the blood was at 113° Fh. In phthisis, he has known it at 114°, and in a case of pneumonia, the blood was 113°. Prevost found the temperature of the body at 110° in tetanus. Granville says it sometimes rises in the uterine system to 120° Fh., and that it depends on the degree of action in the organ. In hydrophobia, where respiration is probably always accelerated, Currie found that "there was no increase of animal heat in any one of five cases."

"The Reformer" says that, "*for a given amount of oxygen the heat produced is, in all cases, exactly the same;*" and that "*the consumption of oxygen in equal times may be expressed by the number of respirations*" (§ 440, no. 5; 441, *b*). But, in stating this, he did not reply to the following interrogatories propounded in my former Essay. Thus: How is the natural temperature maintained in consumption, where respiration is sometimes so greatly impaired as not to be compensated by any acceleration of its movements? Or why is it, when the lungs are impervious from condensation, and their function otherwise greatly impaired by destructive ulceration, the heat rises habitually in the afternoon, even to 114° Fh., and that, too, without any previous reduction of temperature, and often without any increase of respiration?

* I commend, also, to our minute philosophers Mr. Hunter's experiment upon the carp. It was partly intended to illustrate a vision of our author, by which, as he says, "like other schemers, he thought he should make his fortune." But our author had not only the good sense to abandon it, but the magnanimity to hold it up as a weakness of the human understanding.

Why do the palms of the hand "burn" when the rest of the surface is cool? Will chemistry explain? Will it explain, also, at the same time, the analogous phenomena, and the vicissitudes of heat and cold, the quick transitions from one to the other, that are forever perplexing the physician in his treatment of continued, remittent, and intermittent fevers? Will chemistry maintain, in conformity with its doctrine, that these periodical evolutions of heat are due to paroxysmal combustions of the tissues, especially where little remains to undergo the process, respiration obstructed, and yet a high exaltation of temperature? Explain, I say, all this in conformity with the "oxygen and fuel" system, and vitalism will surrender to the devices of human ingenuity.

Why is it, that when the general temperature of the body is at some 85° Fh. it may exist at the *scrobiculus cordis* at 106° and upward?* Mr. Malcolmson states, that in the Asiatic cholera "the skin is sometimes *colder* during life than after death, and a partial rise of temperature over the trunk is *frequently* a fatal symptom." I have witnessed the same phenomena. Mr. M. also observes that beriberi supplies analogous instances; and that when the temperature was extremely reduced, "it was not different when the limbs were closely wrapped in woolen, or when the thermometer was held between the soles of the feet or hands, and free evaporation carefully prevented." Is it not obvious, in these instances, that the power of generating heat was lost in consequence of modified vascular action; and if so, then the generation of heat depends upon vascular action, and is, of course, a vital product. This, too, is most emphatically shown, in the instances here and elsewhere stated, by the "partial rise of temperature over the trunk" just antecedently to death. It is analogous to those cases in which profuse perspiration breaks out in syncope, or as patients are in the act of expiring. It grows out of a powerful reflex nervous influence upon the *vires vitæ*, by which a sudden change of action is induced in the elaborating vessels (§ 637).

Why is the temperature often exalted in congestions of the lungs, "where life is endangered by diminished communication with the air;" and why, in such a case, will "the abstraction of blood diminish the power of producing heat,"† although, by this means, we extend the communication of the lungs with the air? Or, again, in congestions of other organs, when the respiration is natural, the circulation in the lungs unobstructed, but the animal heat greatly reduced, why does it happen that the abstraction of blood will at once exalt the temperature without affecting the respiration, or even increasing the force or frequency of the general circulation (§ 961, *d*)?

In the latter cases, the rationale appears to be, as I have endeavored to explain in my Essay on Blood-letting, that a direct change is exerted by the abstraction of blood upon the instruments of all vital actions, by which the calorific, as well as other functions, are improved or restored. It is here, animating these minute vessels, that we shall find the principles residing by which we are to account for all the remarkable phenomena of animal heat. As the operation of these forces is modified, whether by natural or artificial causes, so will be the phenomena which depend upon them. This is universally true

* See my Letters on the Cholera Asphyxia, and other authors upon this disease.
† Edwards, on the Influence of Physical Agents on Life, p. 275.

of all the manifestations of the organic forces, whether they consist of vital phenomena, or of material products. The function of respiration is just as much concerned with one as with the other, and probably no more. It aids, like the chylopoietic viscera, in perfecting the great material from which bile, urine, the gastric juice, &c., are elaborated by the vital properties and their instruments. And just so is respiration concerned in the production of animal heat.

Again, "sympathy," says Bichat, "as we know, has the greatest influence upon heat. According as this or that part is affected, there is disengaged in others more or less of this fluid. How does all this happen? In this way: the affected organ acts sympathetically on the tonic forces of the part; these being raised, more caloric than usual is disengaged. It is precisely the same as in sympathetic secretions or exhalations. Whether the vital forces are raised by a stimulus directly applied, or by the sympathetic influence they receive, the effect that results from it is exactly the same" (§ 1044, *a*, *b*).

And again, the same accurate philosopher: "Each system has its own degree of heat." This fact was not so well known in Bichat's time as now. But it was his induction from general principles. I shall only advert to the example of the dog's nose, which is familiar to all. Hunter, however, rendered the fact sufficiently obvious;—Davy and others have confirmed it. Now, how exactly all this corresponds with what is known of the vital endowments of particular organs. Where they are most strongly pronounced, there the temperature is apt to be highest, there the phenomena of organic life predominate, and there it is that morbific causes make their most frequent and deep impressions, and develop the most exalted temperature.—(See Essay on *Venous Congestion*, § 8, 9, *in Comm.*, § 1045).

447, *e*. Finally, I come to what I consider an *experimentum crucis*, supplied by an able philosopher, and by one of the most able defenders of the chemical doctrine of animal heat. He states that great differences arise as to oxygen, during the respiration of atmospheric air:

"The real causes are chiefly certain inherent differences in the state of the venous blood, which are indicated, indeed, by other physiological facts, but by none *so unequivocally* as by this variety in the power of altering the oxygen of atmospheric air. The first cause is a difference in the degree of venosity or venalization of the blood in passing through the capillaries." The second and last "cause of diversity in the action of venous blood on atmospheric air is a difference in the proportion of coloring matter contained in the blood."

Now, if the chemical doctrine have any foundation, its advocates should show that there is a greater, or, at least, as great a consumption of oxygen in those states of the system which are attended by an exaltation of temperature, as in the natural condition of the body. On the contrary, however, they show just the reverse of this. Thus, the high authority whom I have just quoted:

"The inferior action of the blood on the oxygen of the air in its passage to the arterial state simply indicates, that it is less removed from a state of arterialization, that is, partakes less than usual of the characters of venous blood. Accordingly, the *least* alteration of oxygen *invariably* occurs in those *febrile* diseases where the *circulation is much excited, and the respiration at the same time free.* These conditions exist most especially in *acute rheumatism;* and it was, there-

fore, in cases of this disease that the four instances of *slight* action (on the air) formerly mentioned have occurred. On all these four occasions the blood was evidently more florid than usual, and in the instance where the *loss of oxygen was only* 0·57 of a cubic inch, the stream from the vein was so bright, that the gentleman who opened it had at first some suspicion that he had opened the artery."*

Here, also, we have, from a distinguished chemist, a philosophical resort to the modified condition of the system in disease, for an interpretation of the wonderful peculiarity of living organized matter in manifesting the power of generating heat.

447, *f.* We have thus again seen that the chemical hypotheses which immediately concern the functions of respiration are surrounded by too many exceptions to come within the pale of nature. These exceptions meet us every where in the habitual state of the animal, and in the history of disease they become almost as multiplied as the individual cases. Here it is that we may most successfully contemplate the law and its operations, in the various modifications which it sustains from the influence of remote causes, and those within the body. Among the latter, are those of the mind, and the derangements to which the lungs are liable, both in their general and organic functions. But far more frequently, and more profoundly, is animal temperature directly exalted, or diminished, by affections of the stomach and of the nervous system. I need scarcely repeat, it would be absurd to have one theory to explain the phenomena of heat in health, and another in disease. It would be a violation of all philosophy, as well as a reckless disregard of all facts. According to the common designs of nature, there cannot be one law for the generation of heat in the healthy state of the body, and another which determines the exalted heat of fever and of local inflammations. While the various functions proceed in their natural manner, the evolution of heat, like the other products, remains without any radical alteration. But when the latter are disturbed in their natural character, the former is liable to corresponding variations, which can be explained only on the principle that the power of generating heat is as much an attribute of vitality as any that may be concerned in the process of disease, and that their various modifications are constantly determined by analogous causes. It is a broad, fundamental principle, that "the general phenomena of the disengagement of heat remain always the same in animals with lungs, in those without them, and in plants, all of which have an independent temperature."

447, *g.* Some chemical philosophers, like the able Edwards, in treating of animal heat, have called to their aid the "*constitution*" of animals to explain certain anomalies which defy the chemical hypothesis. We hear much about the "power of the system to generate heat," without being let into the secret in what that constitution, and that power, consist. To allow that the forces of life have a large and uniform share in the generation of animal heat, would make a repulsive medley, in its connection with the chemical hypothesis. Now that "constitution," and that "power," are something more than ideal; something different from the organized structure; for, in the latter case, many variable phenomena, in adults, proceed from unvarying conditions of structure (§ 1047).

* Dr. Christison, in Edin. Med. and Surg. Journ., 1831, p. 101, 102.

Just so is it with all the varying conditions of animal heat. In health, the varieties are owing to peculiarities in the natural condition of the vital properties; in disease, they arise, like all the other changes from morbid alterations of those properties; and, if the blood sustain any want of its proper influences from defect of respiration, this will contribute toward the modifications of temperature in the same way that it affects the other results of life, and, I apprehend, in no other.

Although Dr. Edwards derives some illustrations regarding the connections of the phenomena of animal heat with respiration from certain morbid conditions of the body, as in asphyxia from carbonic acid, syncope, the cold stage of intermittents, &c., yet it is manifest that he looks upon disease as supplying facts which it is prudent not to investigate. "The question now is," he says, "what is the influence of the respiratory movements on the temperature of the body, when they are raised beyond the rate of health? We cannot answer this inquiry by observations on the sick. *The circumstances are then too complicated to admit of our deriving conclusions from them.*"—*Op. cit.*

In this conclusion I do not at all agree. It is an unwarrantable abandonment of nature for the contrivances of art. Morbid conditions, above all others, give us a clew to the true philosophy. The vital properties are altered by disease, and with them there is a change in all the phenomena and results, of which the modifications of animal heat are one. Hence, it appears to me, that a very obvious "conclusion" may be deduced.

447, *h*. In respect to the natural differences in constitution that are denoted by apparently contradictory facts in relation to animal heat, they are as clearly constituted by natural modifications of the same forces, which are as much, or more influenced by other causes than by respiration; whose power of evolving heat in young animals is greatly and rapidly depressed by the operation of cold, notwithstanding the respiration is accelerated during the first stages of the decline of temperature; but which, again, as the same animals advance in life, acquire the power of completely resisting the same cause without the former acceleration of the respiratory movements; "the animals thus passing from the state of cold-blooded to that of the warm-blooded," while in the hibernating mammalia generation of heat still goes on although respiration have come to a stand, or, when the cold becomes intense, is carried to its highest pitch by the very cause which had produced its great decline; or, the same forces maintain a uniform state of heat when the respiratory movements are greatly accelerated by external heat, and resist equally the heat of the surrounding medium; or, such is their natural susceptibility they may be so influenced by season, that their power of producing heat is said to be less when its production is greatest; which power "may be varied, in some, by suitable food and a graduated temperature;" which "is generally diminished in natural sleep, though modifications occur which change the relation;" which is so modified in the cholera asphyxia, that the temperature may greatly fail while respiration is accelerated, and the lungs free from congestion; or, is undiminished in asphyxia from carbonic acid, "when the respiratory movements are no longer seen;"* or may attain, as in apoplexy, preternatural vigor after respiration and circulation have entirely ceased.

* Portal says that the heat has been known to remain very high in these cases, as in apoplexy, for many hours after death.—*Sur l'Apop*

"Constitution," then, and the "power of generating heat," manifestly relate to the vital properties, and to nothing else. The united operation of these powers, through their instruments of action, results in the elaboration of bile, gastric juice, heat, &c., from the blood. That particular determination by which they eliminate heat, in all parts of the body, may be called a law, though it is but the joint result of the vital powers, concurring in a certain manner to a specific effect. The result is variously affected by climate, season, the quality and quantity of food, stimulants and sedatives, cold or warm air applied externally or to the lungs, by morbific agents, and other causes; or, as the vital properties happen to sustain peculiarities in relation to individuals, age, &c., so will the generation of heat be modified when respiration is exactly the same; and along with those modifications of heat are variations, more or less coincident, of other products. The causes are obvious from the effects. The former are few and simple; the latter are diversified without end (§ 1047).

Most of the reasoning which abounds in authors who believe animal heat to depend specifically upon respiration, or the result of a chemical process, consists in reconciling difficulties by referring them to the vital powers, and sometimes to the entire exclusion of the chemical hypothesis. True, they do not say *vital powers*. They would otherwise be non-conformists. They speak of "constitution"—"the power of evolving heat,"—yet turn into ridicule the only true philosophy, and the only possible thing which they themselves can mean. If they hazard the "term *vitality*," it "is employed for the want of a better," but "without any connection with the mystification which sometimes attends its use;" while others, like Dr. Elliotson, can see nothing in "animal heat," "but a peculiar *state* only;" and here, as in the case of "vitality," Dr. E. "adopts the common language in speaking of animal heat," to make the subject intelligible.

It is from the blood, like all other animal products, that heat is derived. And since decarbonization, and, perhaps, an absorption of oxygen, is indispensable to the healthy performance of all other functions, it is doubtless important to the generation of heat; though manifestly less so in the latter instance, since we see the evolution of heat sometimes going on when respiration is nearly, or quite extinct; while in the cold-blooded animals it exerts but little, if any, influence upon temperature. Decarbonization of the blood, and probably the absorption of oxygen, are among the numerous processes by which its vivification is perfected, and by which it is prepared for an elaboration of the various animal products, and in animals of a certain constitution for the evolution of heat. When respiration ceases, all the most important functions immediately fail; but it is remarkable that the evolution of heat appears to be the *very last*.

I conclude, therefore, that the elaboration of animal heat, and all other secretions, are on a par in regard to principle. It is true, a certain proportion of latent heat may be extricated by the conversion of blood into the solid parts. But this would be counterbalanced by a corresponding change of the solids, particle for particle, into fluids. This appears to me to be fatal to a late doctrine which imputes animal heat to this cause; as well, also, to the condensation of gases. Besides, what becomes of the principle of condensation where the temperature rises after apparent death (§ 447, *d*)? Where is oxygen gas?

447½, *a*. In my former Essay I have also considered the hypothesis relative to the absorption of oxygen gas by venous blood, and the conditions under which it was supposed to unite with carbon, in the process of respiration. It only remains now to state circumstantially the views entertained by Liebig upon this subject.

1. "During the passage of the venous blood through the lungs, it absorbs oxygen from the atmosphere. Farther, for every volume of oxygen absorbed, an equal volume of carbonic acid is, in most cases, given out."

"The globules of venous blood experience a change of color, and this change depends on the action of oxygen."

"The red globules contain a *compound of iron;* and no other constituent of the body contains iron."

"The compound of iron in the blood has the characters of an oxydized compound." "No other metal can be compared with iron for the remarkable properties of its compounds."

2. Many "observations, taken together, lead to the opinion that the globules of arterial blood contain a compound of iron saturated with oxygen, which, in the living body, loses its oxygen during its passage through the capillaries."

The last quotation is a universal theory with our author. By it "the Reformer" interprets all motion, the generation of all power in the animal body, the circulation of the blood, inflammation and fever, obesity and emaciation, the various phenomena of life, and even death itself. "The oxygen of the air and the carriers of oxygen" are all in all. The "carriers lose their oxygen during their passage through the capillaries," when a "combustion of the tissues is set up," which is the true and only cause of the principle of life, of its extinction at death, and of all the unique phenomena of the animal creation (§ 350, nos. 3, 4, 5, 7, 8, 9, 10, 15, 18, 19, 46; § 440, nos 1 4, 5, 6, 8, 9, 10, 11, 12, 14, 16, 1054).

It is not, therefore, remarkable that "the Reformer" should have considered animal heat as life itself,—both the cause and effect of life (§ 441 *e*, 440, nos. 8, 9, 11, 12, 14, 16),—since every known process and result in the animal "machine" is due to "combustion."

3. "The compound, rich with oxygen (no. 2), passes, therefore, by the loss of oxygen, into one far less charged with that element. One of the products of oxydation formed in this process is carbonic acid. The compound of iron in the venous blood possesses the property of combining with carbonic acid, and it is obvious that the globules of the arterial blood, after losing a part of their oxygen, will, *if they meet* with carbonic acid, combine with that substance (§ 440 *f*, no. 18, and *h*). When they reach the lungs, they will again take the oxygen they have lost; for every volume of oxygen absorbed, a corresponding volume of carbonic acid will be separated; and they will again acquire the power of giving off oxygen."

"In their return toward the heart, the globules which have lost their oxygen combine with carbonic acid, producing venous blood; and when they reach the lungs, *an exchange takes place between this carbonic acid and the oxygen of the atmosphere.*"

"The ORGANIC COMPOUND of *iron*, which exists in venous blood, recovers in the lungs the oxygen it had lost; and, in consequence of

this absorption of oxygen, the carbonic acid in combination with it is separated."

4. "Hence, in the animal organism, two processes of oxydation are going on; one in the lungs, the other in the capillaries. By means of the former, in spite of the degree of cooling, and of the increased evaporation which takes place there, the constant temperature of the lungs is kept up; while the heat of the rest of the body is supplied by the latter."—*Animal Chemistry* (§ 438, *b*, *c*).

447½, *b*. If, therefore, we exclude the vegetable kingdom as an important element in our interpretation of organic heat, we shall have seen by this fundamental hypothesis as to the globules of blood that there can be no doubt that the general theory of animal heat has been founded upon certain speculations relative to a limited number of red-blooded animals, and often, as we have reason to suppose, to man alone. It takes no cognizance of all those white-blooded races that possess no ferruginous globules, and therefore no "carriers of oxygen gas," and whose temperature in some instances, as in the bee, approximates that of the human race (§ 444). However much a general theory may draw upon contingencies for its support, it must be universally applicable to the same combination of phenomena. It will not answer to have "ferruginous carriers of oxygen" for one class of animals, and something very different for another class, to explain what is common to both.*

447½, *c*. In the former Essay I have devoted to the questions relative to the elimination of carbon from the blood, and the formation of carbonic acid, all the attention which the subject might otherwise now require; and in another section of this work an argument is presented to sustain my former conclusions (§ 419). In the foregoing Essay I have endeavored to show that the distinguished chemical theorist, Dr. Edwards, is right in his position, that

"Carbonic acid is not formed at once, in the act of respiration, by the combination of the oxygen of the air with the carbon of the blood, but is entirely the product of *exhalation*."—EDWARDS.

I there urged, that the carbonic acid evolved from the chest does not exist in the state of that inorganic compound in the blood; but that the carbonaceous matter exists in intimate union with the blood, from which it is eliminated in the form of carbonic acid gas by the joint agency of the pulmonary mucous tissue and oxygen; the former taking the lead in the process (§ 419). The carbon of the blood is thus readily convertible into carbonic acid while undergoing that special vital process of the mucous tissue. I may quote from the Commentaries a remark which is not less extensively applicable in these Institutes. Thus:

"Before going farther, I may say, that, in having employed, as I shall continue to do, the established phraseology of chemical science, I have assigned many reasons in my first volume, as I shall others in my Essay on Digestion, for believing that every product of the animal system, including the *excrementitious*, is differently constituted in its elements from such as result from the agency of chemical forces; that, what we may find in our test glasses and crucibles has been really different before, or at the time of its elimination from the body. Chemical changes may accrue in excrementitious substances immediately after their elaboration; and the ultimate combination

* I have abstracted blood resembling *milk*, of a slightly reddish tint, from a patient in an ardent state of remittent fever, soon followed by recovery.

may be uniform, especially where, as in carbonic acid, only two elements are ultimately concerned."—*Med. and Phys. Comm., ut cit.*

Although our author, while employed about the chemical rationale of organic products, speaks of them as though they were generated by the living organism as he is accustomed to observe them in the laboratory, and looks upon carbonic acid as equally the product of the organization as of the combustion of carbon (or, in his own language, "*the animal body acts in this respect as a furnace which we supply with fuel*," § 440, no. 1), he now and then yields to the force of facts, and even allows, at one time, that the *iron* of the red globules exists in the state of an "organic compound" (no. 3, this section).—NOTE R p. 1123.

447½, *e*. It is also important to consider that the absorption of oxygen from the air, and the excretion of carbonaceous matter, take place through a highly organized tissue, and the moment life ceases, so also do these processes, notwithstanding artificial respiration. The same tissue, too, which performs those functions, secretes, also, a mucous fluid. This secretion being distinctly the result of vital action, it will hardly be insisted that the same tissue is simultaneously performing, in respect to another product, a mere chemical, or the physical functions of *endosmose* and *exosmose* (§ 419). There is here the same incongruity as we have seen of the chemical theory of digestion, in establishing antagonizing processes for the conversion of food into chyme (§ 358, 360, 374).

447½, *f*. It remains now to notice, of the foregoing quotations (§ 447½ *a*, nos. 3 and 4), another of those extraordinary mistakes in fundamental principles, and where pure chemistry is concerned, which so much abound in our author's work on *Animal Chemistry*.

In the first place, we had been told again and again, that "animal heat is produced by the combination of oxygen with carbon or hydrogen," and in no other way (§ 440). That is the *combustion theory*, and without it there is no animal heat (§ 440, no. 6).

By referring, however, to § 447½ *a*, 2 and 3, it will be seen that oxygen does not unite with any combustible substance in the process of respiration, but only with an oxyd of iron; and that in no. 4, it is asserted that by this supposed union of oxygen with iron "*the constant temperature of the lungs is kept up*, in spite of the degree of cooling, and of the increased evaporation which takes place there." "*Hence*," says Liebig, "*in the animal organism, two processes of oxydation are going on; one in the lungs* [the union of oxygen with an "*organic* compound of iron"], *the other in the capillaries* [the union of the absorbed oxygen with carbon, &c.]. *By means of the* FORMER, *in spite of the degree of cooling, and of the increased evaporation which takes place there, the constant temperature of the* LUNGS *is kept up; while the heat of the* REST OF THE BODY *is supplied by the* LATTER."—LIEBIG.

The general concurrence, even of chemists, in the foregoing exposition of the laws of animal heat, can alone justify any farther comment. But the work must be efficiently done to operate as a perpetual barrier to the pernicious invasions of chemistry.

I say, then, in whatever aspect the foregoing statement may be regarded, it is deeply discreditable even to chemical philosophy. In the first place, a distinct chemical provision is made for the "lungs" and for "the rest of the body," respectively, for the maintenance of

the same uniform temperature in all the parts, while it is assumed that the union of oxygen with the iron of the blood is exactly equivalent as a source of heat, and under all circumstances, to the union of oxygen with carbon and hydrogen in the process of combustion; without regarding the auxiliaries, "clothing," "laborious efforts," "cold water," &c., which are brought to the aid of the chemical process in "the rest of the body."

But that is not the worst of the doctrine; for it denies to the lungs any participation in that combustive process which is not only the foundation of animal heat "in the rest of the body," but of every result which appertains to life. Chemistry, of course, abandons the ground; but it must carry with it a mortification which is due from the physiologist (§ 350, *mottoes a, b, c, d, e*), and a farther recognition of the justice of the rebuke administered by Hunter (§ 350, no. 97).

It will have been seen, however, that the foregoing is only one of a constant succession of blunders whenever the chemist trespasses upon organic life. And were we to look yet farther into the last of the series, it would be found laden with objections. The physiologist, for example, has a right to insist that the general doctrine shall apply as well to the lungs as to the "rest of the body," and that there is an equal combustion of both. The chemist, therefore, necessarily places the temperature of the lungs at 196°, in making the union of oxygen with the iron of the blood equivalent to the combustive process. And having thus rectified the hypothesis, we find ourselves presented with a fundamental auxiliary to the general principle, that its integrity may be preserved in the lungs which are beyond the reach of "clothing," while the surface of the body, which is more exposed to the operation of cold, is left to the general principle supported by the contingencies of dress, along with those other provisions, "food," "laborious efforts," "candles," &c., that are designed for the maintenance of the same temperature in "the rest of the body" which is accomplished by the two chemical processes in the lungs (§ 440, nos. 10, 11, 12, 13, 14).

While now adverting to the subject of carbonic acid in its supposed relation to animal heat, I will place in contrast two doctrines by our author, which make up a part of his system of pathology, as the best evidence I can offer, in parting forever with Organic Chemistry, of the sincerity of the motives which have governed the demonstrations I have endeavored to make in behalf of sound philosophy, the honor of my profession, and the best interests of man (§ 1 *b*, 350¼, 376¾ *b*, 820).

CHEMISTRY *as founded on the basis of "Experimental Philosophy."*

"We find, in point of fact, that the living blood *is never*, in any state, *saturated* with carbonic acid; that *it is capable of taking up an additional quantity*, without any apparent disturbance of the function of the globules. Thus, for example, after drinking effervescing wines, beer, or mineral wa-

PHYSIOLOGY *as founded on the basis of "Experimental Philosophy."*

"If we consider the fatal accidents which so frequently occur in wine countries from the drinking of what is called feather-wine, we can no longer doubt that *gases of every kind*, whether soluble or insoluble in water, possess the property of *permeating animal tissues, as water permeates unsized paper*

ters, more carbonic acid must necessarily be expired than at other times. Less, however, will be given out after the use of vat and still wines, than after Champagne."—LIEBIG'S *Animal Chemistry.*

This poisonous wine is wine still in a state of fermentation, which is increased by the heat of the stomach. The *carbonic acid gas* which is disengaged, *penetrates through the parietes of the stomach, through the diaphragm, and through all the intervening membranes, into the air-cells of the lungs, out of which it displaces the atmospheric air.*"—LIEBIG'S *Animal Chemistry* (§ 350, nos. 24, 43).

448, *a.* The main objection to the vital doctrine of animal heat, or that which places it on the common ground of secreted products, seems to have arisen from a difficulty of comprehending the manner in which heat can be generated by any process than such as has been most familiar to the senses. The objectors, however, have no difficulty in assuming that the "nervous power governs the chemical forces in the formation of animal heat." This admission of the instrumentality of the nervous power is founded upon certain irresistible facts which chemistry cannot appropriate, and goes very far in allowing the force of analogy which refers the production of animal heat to the same great principles of life that are known to preside over all other products of animated beings.

448, *b.* But, is there any stability to the doctrines which relate to the evolution of caloric in the inanimate world? None at all. Even Lavoisier's hypothesis is overthrown.

"A new theory is, therefore," says Turner, "required to account for the chemical production of heat. But, it is easier to perceive the fallacies of one doctrine, than to substitute another which shall be faultless, and it appears to me that chemists must, for the present, *be satisfied with the simple statement*, that *energetic chemical action does, of itself, give rise to increase of temperature.*"—TURNER'S *Chemistry.*

448, *c.* Let us now borrow from the same distinguished chemist, an example by which the foregoing statement is sustained, and which will remove all difficulty as to the problem that animal and vegetable heat are elaborated by the organic force through the instruments of vital action, according to the other products of organic beings. Facts will receive their proper interpretation, an important analogical induction will remain inviolate, while the uniformity of other secreted products, coinciding with the uniformity of temperature, or each varying together under the same vital influences, expounds the latter phenomenon and corroborates the vital interpretation. Thus, Turner:

"It is a well-known fact, that *increase* of temperature frequently attends chemical action, though *the products contain much more insensible heat than the substances from which they were formed.* This happens remarkably in the explosion of gunpowder, which is attended by intense heat; and yet its materials, in passing from the solid to the gaseous state, expand to at least 250 their volume, and consequently render latent a large quantity of heat."—TURNER.

448, *d.* Now, although it be allowed that phenomena of the foregoing nature may have been explained by supposed differences be-

tween specific and latent heat, they show us that heat exists, and is developed, under different conditions; and to expound the variety of results in the mineral world, it has been necessary to multiply yet farther the natural states of caloric (§ 448, *e*, 1085).

448, *e*. As showing farther, also (*c*), that there is some obscurity attending the phenomena of ordinary combustion, I may quote the high authority, Dr. Kane, to that effect, who says, that,

"Laying aside altogether the attempt at deducing the phenomena of combustion from any change in the amount of latent or specific heat in the bodies which enter into combination, it remains only to be admitted as a general and independent principle, that chemical combination is a source of heat and light. It is, however, impossible to arrest inquiry at that point; and, accordingly, the *speculations* of philosophers have been directed, in seeking a cause for the phenomena of combustion, to the disengagement of electricity," &c.—KANE'S *Elements of Chemistry*, 1841.

448, *f*. Now, however it may be that the results are the same in the inorganic world, upon the theories either of caloric or electricity, the remarkable differences in views in that respect show the difficulties which chemistry must encounter when it approaches the philosophy of organic heat; and this, especially, when we consider the vital nature of the development of electricity and light in living animals. —(See *Medical and Physiological Commentaries*, vol. i., p. 107–119.)

The physiologist undertakes no explanation of the *modus* in which organic heat is elaborated. He avoids all inquiries of that nature, although he might proceed to interrogate the manner in which the vital principle operates with as much propriety as the chemist "speculates upon the cause of the phenomena of combustion." But, in doing this, he would trespass upon inscrutable difficulties, and encumber philosophy with useless hypotheses.

8. GENERATION.

449, *a*. The eighth and last great function common to animals and plants is generation. This function, being alone designed for the perpetuation of the species, is not necessary to organic life. It is here, however, in all the processes that are connected with the formation of the germ, and of semen, in the preparation of the generative organs for impregnation, in the mental and physical circumstances attending the act of copulation, in the impregnation of the ovum, in the development and growth of the fœtus, in the sympathetic influences of the uterus upon the mammæ which result in the formation of milk, and in all their individual and connected designs, and in their great final cause of perpetuating the species, and in the various incidental provisions which are supplied for the fulfillment of that end, that chemistry and physics may be as effectually banished from physiology as by the demonstrations which I have made in relation to the germ, or by those which respect digestion, or organic heat, or the nervous power.—See YOUTH p. 376–380, § 578.

449, *b*. What may be the extent in which the male participates in producing the offspring it is impossible to know; probably as impossible as a knowledge of Creative Energy. We know, however, that the male and the female impress, alike, their own moral, vital, and physical character upon it. But the mother supplies the germ, also.

449, *c*. In another work I have examined the merits of the old doctrines of seminal animalcula, and their germinal character; lately revived along with other illusions or pretensions of the microscope. The subject is scarcely worthy a renewed discussion (§ 131).

449, *d*. It may be finally said, that whatever is true of the essential physiology of generation, as it relates to animals, is equally so of plants. The coincidences, too, which are so striking in this function of the two organic kingdoms, remove every ambiguity which has been supposed to attend the more important functions of plants, confirm the vital character of the whole, and, with the universal analogies, refer the whole to the same properties of life which carry on the organic functions of the animal kingdom. It were impossible, according to the ways of nature, that a function, like generation, which depends in animals upon a vital condition of all other processes, and which is a great final cause of all those processes, should, in plants, depend on others of a different nature. By the coincidences, therefore, in the function of generation between animals and plants, I prove a like coincidence in the vital character of all the organic functions of both animated kingdoms (§ 185, 1052 *c*).

But little can be said relative to the function of generation, beyond certain important relations that have been considered, that can serve as a ground for Institutes in Medicine (§ 63–81). Its more extended consideration belongs to elementary works on physiology.

II. PECULIAR, OR ANIMAL FUNCTIONS.

A. *Functions of Relation.*

1. SENSATION.

450, *a*. HAVING distinguished three kinds or principal modifications of sensibility, namely, *common*, *specific*, and *sympathetic*, and as sensation is performed through that property, there are naturally three modifications of the function; to wit, common sensation, specific sensation, and sympathetic sensation (§ 194–204, 1037 *b*).

450, *b*. The nerves are the organs of the functions, and the nervous centres the recipients of the transmitted impressions. But, it is important to remark, that the parts most essential to sensation are the extremities of the nerves at their origin and termination, and that the trunks are, mainly, the conductors. This is also true of voluntary motion, and of those involuntary movements that are excited by the nervous power. The nerves of the organic viscera, therefore, follow this rule, as it respects all natural, morbific, and remedial agents. A neglect of this consideration has led to fallacious conclusions in medicine from experiments on the trunks of nerves (§ 110–117, 826 *d*).

450, *c*. Common and specific sensation require a continuity of the nerves with the brain, and a co-operation of the mental power perception. Sympathetic sensation may be excited in the brain, or spinal cord, or certain parts of the ganglionic system, either in their connected state, or when disconnected. In their most natural condition it is probable that all the parts concur more or less together in giving rise to sympathetic sensation; though some parts more than others, according to the nature of the impressions transmitted and the part from which they are transmitted (§ 201, 1037).

450, *d*. Common sensation appertains to all parts, and is the cause of pain. In the natural state of the body it is inappreciable, but may be greatly roused by injuries and by disease. Its intensity will then depend upon the nature of the part and the exciting cause. It is apt to be most exquisite in parts where specific sensation is least; as in tendons, ligaments, membranous tissues, &c. (§ 198).

450, *e*. Specific sensation corresponds with specific sensibility. It is the function through which we acquire a knowledge of external things, and is, therefore, the great inlet of knowledge. It has, of course, the several modifications which appertain to specific sensibility (§ 199, 200); consisting, indeed, of five apparently different functions. The expanded nerves of sense, which are the organs of this function, it is superfluous to say, are supplied with auxiliary means, such as the various appendages to the retina, to the auditory nerve, &c. A close analogy exists among the whole, and they may be brought more or less to the aid of each other. Although a common function, its remarkable modifications are shown by their uses, respectively, and by the necessity of certain specific stimuli to each. As with common sensation, the specific kind requires the aid of perception. The *rationale* of the entire function is far more wonderful and incomprehensible than that of sympathetic sensation and its various results which terminate in the influence of the nervous power on organic actions, and for which the grossest doctrines in chemistry and physics have been substituted, because the vital interpretation is "inconceivable," or cannot be subjected to the critical inspection of that far more obscure, but acknowledged, causation in the chain of perception, specific sensation (§ 222–237). What can task the understanding more than the step in the process of intellection as connected with the functions of sense; beginning with light and its properties, or with the odor which none but the dog can discern, or the abstractions that convey to the mind all the varieties in taste, or the modified undulations of air which render so distinct from each other all the gradations of sound, from the Æolian harp to the braying of a jackass; the impressions of each upon the extremities of the nerves of sense, one alone upon the eye, another alone upon the nose, and another upon the ear alone; the transmission of these impressions along the trunks of the nerves to their other extremities in the brain, and in each of the cases through the aid of some special mechanism; their excitement of the brain and the co-operation of the mind, by which the nature of the primary impression is discerned, and the external objects realized by the inward immaterial agent according to their real material existence (§ 188½, *d*, 500, *nn*)?

450, *f*. The common hypotheses which have been propounded to explain specific sensation, such as the motion of a nervous fluid, galvanism, vibration of the nerves, the passage of light, of undulations of air, &c., to the brain, betray a general disposition to avoid the phenomena of life for those which are manifested by inanimate objects. But, of this I have already had enough (§ 189, 234–237).

451, *a*. The action of material objects upon the mind through the function of sensation, and the astonishing influences of mental emotions upon irritability (§ 188, *a*), and of the will in acts of voluntary motion § 227, 1st, 233), bring the laws of organization and those of the immaterial mind and instinct into harmonious relation; while the

nature of mind and the impressions it receives illustrate the character of the vital properties (§ 450 *e*, and *Medical and Physiological Commentaries*, vol. i., p. 92–102).

451, *b*. Impressions upon the brain through the medium of specific sensation leave no transcript; and perception of objects without sensation, as in reveries and dreams, has led to a denial of the materiality of the world; supported, too, by far greater ingenuity than those objections to a vital principle which are regardless of all its unique phenomena.

451, *c*. It has been seen that perception is necessary to sensation, in the usual acceptation of this function, which is essentially mental. This term, however, is employed to represent the cerebro-spinal impressions which give rise to involuntary motions, whether in animal or organic life; and "feeling" is used by Mr. Hunter, and others, to denote the susceptibility of organs to the existing condition of each other, by which their concerted action is maintained through the medium of the nervous system. It is obvious, however, that the mind takes no cognizance of those impressions which result in involuntary motions; no perception, no act of the will, is excited, so far as it respects the direct results. And, although there be an analogy between all the influences of sensation in animal life, it reaches least to the movements which spring from the nervous system in organic life, since the impressions made upon the brain through specific sensation never affect the organic actions; while there is a perfect identity of effect between those impressions which give rise to involuntary movements in animal and organic life.*

451, *d*. As the term sensation, therefore, has a very different import in the different cases; and as in one the transmitted impressions terminate in exciting an act of the mind, while in the other no such act is called into operation; but differently, also, from the former case, the nervous power is excited in the nervous centres and then reflected with the effect of a vital agent upon all other parts (§ 226); and since, also, the impressions through specific sensation must be exerted upon the brain, while in the latter case the results may be equally pronounced whether the impressions be made exclusively upon the brain or on the spinal cord or organic nerve, I have made a third distinction in sensibility to separate its office in the function of sympathy from its province as described under the varieties of common and specific sensibility, and to avoid the confusion which has hitherto prevailed by an indiscriminate use of the term *sensation* (§ 194, 199½, 201, 204, 453, 523, 1037 *b*).

451, *e*. This third distinction in sensibility I have called sympathetic sensibility (§ 201); and this conducts me to a third distinction in the corresponding function, and which should be known by the same epithet (§ 464–467, 473 *c*, no. 5, 474, no. 4).

The epithet *sympathetic* denotes the special function of sympathetic sensation, which has been sufficiently described in the preceding section, and in what has been said of sympathetic sensibility (§ 201–204).

451, *f*. The considerations made in § 450, *e*, illustrate the vital philosophy of sympathetic sensation as one of the functions concerned in the transmission of impressions from one part to another through the medium of the nervous centres, and in which the nervous power is the agent by which the reflected impressions are exerted (§ 222, &c.).

* If specific or common sensation affect organic actions, it is through some mental emotion which it excites. The mind is the efficient cause, p. 77–79, *note*.

The facts in the former case bear with the strongest force of analogy in demonstrating the entire absence of all chemical agencies in the phenomena of the nervous power. The alliance of the whole, throughout the mental and physical results of specific sensation, places the whole upon common ground in respect to principle; and if it be true that nervous agency in one case is chemical, it is equally so in all, and equally so with perception itself (§ 188½, *d*). Other demonstrations to the same effect will be presented in another section (§ 500, *nn*).

2. SYMPATHY, OR REFLEX ACTION OF THE NERVOUS SYSTEM.

452, *a*. I now enter upon the consideration of a function which belongs not only to animal life, but has far greater and more important relations to the organic life of animals. Although it have no existence in the vegetable kingdom, where its anatomical medium is also wanting, it does not bestow those striking distinctions in the organic life of the two animated departments of nature which the importance of the function, and the presence of the nervous system, in the animal economy, would denote. The organic actions are essentially alike in both, conducted in both by common properties appertaining to the various tissues and organs, and only influenced in animals by reflex and direct action of the nervous power as a vital agent (§ 185).

452, *b*. Nevertheless, it is a function of wonderful characteristics, and can be appreciated only by an extensive investigation of its endless variety of phenomena. And yet is this function extensively ridiculed by enlightened men; and even Müller, who has written more luminously upon its laws than any other observer, applies them only in certain natural processes, considers the nervous power the actual cause of motion, construes the function of absorption according to the physical rationale, defends the hypothesis of endosmose and exosmose *in extenso*, interprets all the secreted products upon chemical principles, expounds diseases by the humoral pathology, and recognizes no therapeutical influences of medicine but through its absorption into the circulation. For all this he was well commended by the British and Foreign Medical Review, while the same critical survey of that remarkable work on Physiology stamped its displeasure upon those doctrines of life which render the work a proud monument of the age.

Again, no one has employed his knowledge of the laws of sympathy more usefully than Bichat. "The word," he says, "is of but little consequence, provided what it expresses is understood." And yet, while he also affirms that "we know the principle exists," he also says, that the "word is only a veil for our ignorance in respect to the relations of the organs to each other" (§ 234).

452, *c*. Sympathy is the most important function which is peculiar to animals; since upon it depend, very greatly, the right performance of the organic functions, and a vast range of pathological conditions, and the greatest amount of therapeutical influences. It also overthrows the venerable doctrines in humoralism, in all their contemplations of vitiated blood, morbid lentor, "living putrefaction," and of those conformable therapeutical means which were invented under the significant names of incisives, deobstruents, inviscants, incrassants, diluents, attenuants, astringents, relaxants, refrigerants, &c.

453. Sympathy has been commonly reputed as one of the properties peculiar to animals; but it is not only a function, but one of great

complexity, since it involves the united operation of sensibility and the nervous power. The result of that concerted action is sympathy, or reflex nervous action. This is the established acceptation; but the nervous influence often operates through motor nerves alone, as in mental and physical excitements of the nervous centres; and hence, in part, my preservation of the generic term *sympathy* (§ 638½).

In the farther prosecution of this subject, I shall consider,

I. The general uses of the nervous systems.
II. The different orders of nerves (§ 462, &c.).
III. Exp. to determine the Laws of the Vital Functions (§ 476, &c.).
IV. The varieties or kinds of sympathy (§ 495, &c.).
V. The laws of sympathy, and their application to pathology and therapeutics; the latter being peculiar to myself (p. 912).

I. OF THE GENERAL USES OF THE NERVOUS SYSTEMS.

454, *a*. The phenomena of the nervous systems (the cerebro-spinal and ganglionic), in their connection with organic processes, forcibly declare how broad is the gulf between the properties and laws of dead and living beings, and how vast, magnificent, and profound is the science of life in its varied aspects of health and disease.

454, *b*. The nervous system having no existence in plants has given rise to the fundamental distinction of "animal and organic life" (§ 96–123), although in animals it belongs to both lives.

454, *c*. The cerebro-spinal system appertains particularly to the organs of animal life, though it contributes largely to the organic viscera (§ 111–117, 224, 233⅘, 356 *a*, 409 *k*, 461, 478 *b*, 488½, 493 *cc*, 647½, 893½).

The ganglionic system is universally appropriated to the organs of organic life, and pervades every part of the animal; since organic actions are carried on as well in the organs of animal life as in the organic viscera, and require the influences of this system (§ 115).

455, *a*. The great final cause of the brain is to subserve the intellectual powers in man, and instinct in the lower animals (§ 241, 454 *b*, 500 *p*). But reason and instinct would avail but little were their operations circumscribed by the limits of their organ. Hence the brain is prolonged into nerves, and various connections are thus established with all parts of the body, and with the external world. Admirable as is this Design of associating in harmonious action the immaterial with the material parts, it would still be defective, and the economy of nature obviously violated, were not an organ so prominent in the animal mechanism rendered subservient to the great purposes on which its existence depends. Therefore that other system, the ganglionic, has been established, with intimate connections with the cerebro-spinal, through which they co-operate together, especially after independent life begins. Nevertheless, the essential influences in organic life devolve mostly upon the ganglionic system, whose principal offices, besides that of combining the organic functions (§ 113), consist in so modifying the functions as to variously affect the secretions in their quantity and quality (the organic in their vital constitution), and in supplying the stimulus of nervous influence to the muscular tissue in organic life (§ 224, 356 *a*, 422, 461, 461½, 473 *c*, 475½, 483 *c*, 488½, 500 *g*, *m*, 524 *d*, no. 7, 889 *g*, 892¾, 893 *a*, *c*, 893½, 902 *g*).

455, *b*. It appears, therefore, that one of the great secondary uses of the cerebral system is that of co-operating with the ganglionic in

establishing a circle of sympathies among the organs of organic life and preserving the whole in that harmony of action that is indispensable to the life of complex animals.

455, *c.* Thus we learn that the various parts of the organic mechanism of animals are not only indispensable to each other, but that a certain established influence of one upon the other is necessary to each, and that the functions of the whole may be fatally deranged, either directly, by causes that may interrupt the common chain by which the relations are established, or indirectly, as by a blow on the stomach, or by poisons acting upon some part of the intestinal mucous tissue, or by withdrawing some particular organ from the symmetrical whole (§ 109, 129).

455, *d.* Whatever, indeed, may affect the powers and embarrass the functions of the cerebro-spinal system, will more or less disturb this concert of action, may modify the functions of every part, and may derange the whole series of vital phenomena. The nature of the disturbances will depend entirely upon the nature of the impressions produced upon the nervous systems, as well as upon the rapidity and violence with which the impressions are made. Direct injuries do it in one way, and according to their nature and extent. Morbific, or other causes, acting upon other parts, affect the nervous centres, and consequently give rise to remote derangements, in other ways, according to their nature, and the violence with which they operate. Medicines do the same thing, and according to their nature, their dose, and according to the nature of the part, as well as the existing state of the part to which they are applied, or that of other parts upon which they may act sympathetically. Intricate reflex nervous actions, in all these cases, are liable to spring up, and that, too, in rapid succession (§ 222–233¾, &c.).

455, *e.* The same laws, precisely, are concerned throughout. We do not, however, witness the display of reflex nervous actions in health as in disease, or as when remedial agents operate; since, in the natural state of the body, the nervous influence is more or less *in equilibrio;* operating uniformly and equally on all the organic viscera, and thus maintaining among them one concerted, harmonious action. But this power being constituted with the greatest sensitiveness to the various conditions of all parts, that it may transmit the existing condition of each one to the whole (as strikingly seen in the almost instant interchange of function between the kidneys and skin, on the contact of cold air, &c., § 422), it necessarily happens that when the state of any one part is varied from its natural standard, that part will transmit an unnatural influence to the brain and spinal cord, will develop the nervous power in an unnatural manner, and thus produce disturbances in other parts (§ 350, no. 19). The alterative influences, therefore, of morbific and remedial agents necessarily result from the natural physiological laws of the nervous system in connection with the instability of the organic properties, nor can it be otherwise. The principle is absolutely ingrafted upon the constitution of animals.

455, *f.* I say, therefore, that when unusual causes operate, whether upon the nervous centres or upon remote parts, they necessarily develop the nervous power in greater intensity than it exists in health; when it is reflected abroad upon various organs, and with the greatest variety of effect. The parts upon which it may fall will depend upon

their existing susceptibility and the nature of the remote causes; and the nature of the effects produced will depend greatly upon the particular virtues of the morbific or remedial agents; for it is also an important law that the nervous power itself will be altered according to the particular nature of the impression which may be produced upon the part on which the agent may exert its direct effect (§ 222, &c.).

455, *g*. The actions which are thus influenced through the connecting medium of the nerves are not alone the great general functions of organs, such as digestion, the action of the heart, &c., but, also, those of their minute constitutional organization. Here it is, indeed, that morbific and remedial agents exert their principal effects (§ 483, &c.).

456, *a*. In the ordinary rhythm of the organic system, however, the capillary and extreme vessels are not as dependent on the nervous influence for the precision of their functions, as the complex organs (§ 455, *e*). It is greatly with these vessels as with the analogous ones in plants. They have an independent function in each particular part, the performance of which does not require so much a harmonizing nervous influence as in the collective sense. Herein also is seen a reason of the absence of a nervous system in plants, while it is more or less necessary to animals. The vessels go up continuously from the roots to the leaves, and continuously back again, and there are only vessels; no complex organs. Each part of a plant has within itself an organization adequate, or nearly so, to its independent existence. It is otherwise, however, with animals. Here, other essential parts are superadded to the simpler mechanism, are made dependent on each other, and a certain correspondence of action rendered necessary to the integrity of the whole. For the fulfillment of these ends the nervous system is also superadded, with its wonderful attribute, the nervous power, that a perpetual change of influences shall be maintained among the great organic viscera, while it is also made instrumental in exciting and modifying the organic functions of every part, and thus also affecting the nature of the products (§ 226, 232, 399, 446 *a*, 461, 473 *c*, 483 *c*, 485, 489, 512, 746 *c*, 846, 889 *g*, 902, 952).

456, *b*. Hence it is that slight influences upon the nervous centres will determine the nervous power, with a very manifest effect, upon the capillary and extreme vessels, as seen in blushing, and in the experiments by Philip (§ 227, 477, &c.); and coming to the ordinary operation of disease, and of morbific and remedial agents, we have constant demonstrations of the great susceptibility of these vessels to the action of the nervous power, and of strong reciprocal sympathies among them, and of consequent changes in the products (§ 394, 1040).

457. One of the most striking peculiarities of the ganglionic system is that of its not transmitting the influences of the will to the organs which it supplies, notwithstanding it is so intimately combined with the cerebro-spinal nerves; while, on the other hand, the passions operate more powerfully through the ganglionic than through the cerebro-spinal nerves (§ 476 *c*, 500 *e*).

This fact shows us at once that the sympathetic system must have certain special functions; and when we trace out its anatomical constitution, and its distribution to the essential parts of organic life, we perceive that one special office must be that of maintaining a harmony of actions among these parts; and experimental observation confirms this induction. Consequently, from the exquisitely delicate nature of

this high office the nerve is rendered intensely susceptible, and from the intimate manner in which it pervades the organic tissues it is made to exercise a profound and somewhat governing influence upon their organic actions (§ 456 *b*, 1040).

458. The relations of the cerebro-spinal and ganglionic systems to each other, their special or mutual functions, and those of individual nerves, all having their distinct individuality, yet all more or less related and concurring in harmony, and for important purposes in animal and organic life, supply the most complex and astonishing instances of Design to be found in nature; and their natural attributes, existing under the most absolute laws, afford a ready interpretation of the endless phenomena of reflex actions, as the result of disease, or of morbific or remedial agents.

459, *a*. All parts of the nervous centres are not only more or less mutually connected in function, but all parts of the nervous system are subordinate to the brain. There are no distinct, separate, and independent influences, of an involuntary nature, exerted by any parts of the nervous centres in their state of integrity. They all concur more or less together. This is experimentally demonstrable, as well as denoted by the natural phenomena. If, therefore, it should appear from experiments upon the spinal cord, for example, while connected with the brain, through any remaining communications, that the influences are determined by the cord alone, we may be assured that the brain has participated (§ 201, 473, 481, Exp. 15).

459, *b*. I have said in my Essay on Bloodletting (in Med. and Phys. Comm.), that the injuries which are inflicted on the spinal cord, to determine the specific functions which have been assigned to it, are so severely propagated to the brain, and may so affect the properties of that organ, that the results which appear to flow from the spinal cord may be actually due to the cerebral influence, or to an interruption of that influence when the spinal cord is divided or destroyed. Both principles, in the latter case, may act in co-operation; the cerebral influence being determined through the superior nerves and the ganglionic system, and otherwise impressed by a reflected influence from below that part of the spinal cord, where its direct connection with the brain is interrupted (§ 481, Exp. 12, 15).

While, therefore, the brain remains, experiments upon the spinal cord are entitled to much less confidence than those which are made upon the brain. But even when the brain is removed, the vital properties of all parts become so profoundly modified in consequence, that we can scarcely infer with accuracy the specific functions of the spinal cord from subsequent experiments (§ 477, &c.).

459, *c*. The late experiments by Dr. Stilling, with strychnia applied to the spinal cord, are entirely consistent in their results with the foregoing remarks (*b*). From these experiments he supposes that the spinal cord is greatly independent of the brain, and that when divided in numerous places, each portion is capable of the same influences upon the parts it may supply, as when the whole cord is in its natural state. Thus, when the small portion connected with the fore-legs is separated from the rest of the cord by two incisions, and strychnia is applied to this isolated part, the legs will be convulsed. Still, however, there are remaining and important communications of this apparently isolated part with the head, and with all other parts of the

spinal cord, which will forever embarrass these critical inquiries, unless there be a removal of the brain (§ 473 *a*, no. 2, 473 *c*, 494 *d*, 514 *e*).

459, *d*. "The experiments of M. Le Gallois," says Wilson Philip, "prove, in the most satisfactory manner, that a principal function of the spinal marrow is to *excite* the muscles of voluntary motion, and that it can perform this office independently of the brain, as after the removal of the brain. Yet we constantly see injuries of the brain impairing the functions of the spinal marrow. Of this apparent inconsistency, M. Le Gallois justly remarks, that two facts, well ascertained, however inconsistent they may seem, do not overturn each other, but only prove the imperfection of our knowledge."

Now, in the foregoing case, there is no difficulty in reconciling the facts by the interpretation which I have given to the action of the will and of the nervous power. The will operates as an exciting cause to the nervous power, which then determines voluntary motion. But, the motions are never voluntary after the removal of the brain; but the nervous power pervades the whole system of motor nerves, and when stimuli are applied to the spinal cord after removing the brain, the nervous power becomes an exciting cause of involuntary motions (§ 226, 473, 500).

459, *e*. Every principal part of the nervous system has a certain special office which is exercised in conjunction with the whole. "The cerebrum does not act like the cerebellum, nor the cerebellum like the medulla oblongata, nor the medulla oblongata like the spinal cord and nerves. In the cerebral lobes resides the faculty by which the animal thinks, wills, recollects, judges, becomes conscious of sensations, and commands its movements. From the cerebellum is derived the faculty which co-ordinates the movements of locomotion; from the tubercula bigemina or quadrigemina, the primordial principle of the action of the optic nerve and retina; from the medulla oblongata, the motor or exciting principle of the respiratory movements; and, lastly, from the spinal cord, itself, the faculty of blending or associating into combined movements the partial contractions immediately excited by the nerves in the muscles of animal life."

459, *f*. Enough, however, is known to show us, that when the cerebro-spinal and sympathetic systems exist as a whole and unimpaired, they act more or less as a whole; but that different parts have certain peculiarities of function, and that when injuries befall any part of these great systems, a portion of the whole may perform certain circumscribed functions, at least for a limited time, and often, perhaps, as perfectly as the whole apparatus in its state of integrity (§ 201, 515, 516 *d*, no. 8).

Impressions, as I have said, when transmitted through sympathetic sensibility, may be received either by the brain, spinal cord, or certain parts of the ganglionic system; and either connectedly or independently. But, in the natural state of the nervous system, all such impressions, when received especially by an individual part, are doubtless propagated to the other parts, and institute that harmonious concurrence in all the parts which renders the whole nervous system instrumental in determining the ultimate phenomena. This is even true of so local a phenomenon as the contraction of the sphincter muscles, however that contraction may be maintained after destruction of the brain and of the superior parts of the spinal cord (§ 461½, *a*). These

conclusions are warranted in experiment, and by all that is known of the dependence of the harmonious relations of organs upon the presiding influence of the nervous system. There must be harmony there as a fundamental requisite (§ 129).

459, *g*. In the application which I have made of the nervous power, in the present and in my former works, to the theory of disease and to the modus operandi of remedial agents, it is important to regard the whole nervous system in its unimpaired relations to its own and to other parts.

460. No experiments upon the sympathetic nerve can show that it is more than tributary to the organic processes; for the moment any unusual impressions are made upon it, the nervous influence is unnaturally excited, and determined with more or less violence upon the organic properties, and thus deranges the functions.

461. It is an assumption to say that the nerves are the generating sources of the secreted products, however certain it may be that they influence the organic processes and their results. If the products are altered by impressions made upon the brain or nerves, it is because the nervous influence is preternaturally determined, as a morbific agent, upon the organic viscera, and because the nervous influence exerts naturally a modifying effect upon the products of organic actions. A division of the pneumogastric or of any other nerve may have all the effect of a morbific agent, producing congestion and inflammation; the very division of the nerve determining a shock of the nervous power upon the organic properties of the part to which the nerve is distributed. But, in the instance of dividing the pneumogastric nerve the gastric juice and the pulmonary mucus are secreted in preternatural abundance. Digestion, however, becomes at once greatly impaired; but even that may be more or less restored by rousing the nervous influence in the divided portion of nerve leading to the stomach by means of galvanism, or other irritants applied to the nerve, thus perfecting the juice (§ 226, 409 *k*, 446 *a*, *c*, 489, 493 *cc*).

461½, *a*. The brain and spinal cord are not necessary to the organic life of the fœtus, not even to the action of the sphincter muscles; since both have been wanting in the full-grown human fœtus (§ 459 *f*). In the fœtal case reported by Dr. Clark in the London *Philosophical Transactions* (1793, p. 154), in which it is said that there was no trace of nerves, it cannot be doubted that the sympathetic existed, since the laws in respect to the organic compounds of animals are as applicable to such a monster as to the perfect being, and since also these compounds in the latter case are imbued with special vital conditions through influences of the sympathetic nerve upon the secreting vessels. The sphincter ani, the heart, &c. require the stimulus; but there was no anus in the above case (§ 409 *k*, 473 *c*, 483 *c*, 488½, 493 *c*, *d*).

461½, *b*. Hence it appears that the sympathetic nerve is, to a certain extent, independent of the brain and spinal cord, and the relations of the latter to the former become most important after independent life begins (§ 224, 473 *c*, 483 *c*).

461½, *c*. In brief, then, the influences of the cerebro-spinal and sympathetic systems are more or less reciprocal in organic life. And, although sympathies may be combined by the ganglia of the sympathetic nerve, as in contiguous sympathy (§ 497), this nerve transmits the impressions it receives to the brain and spinal cord in the same

way as the cerebral and spinal nerves, and influences are propagated from the cerebro-spinal axis upon either system of nerves, and the organs they supply, in a like manner (§ 111–117, 227–230, 455, 893).

II. OF THE DIFFERENT ORDERS OF NERVES.

462. Corresponding with the two important functions of the brain and spinal cord, those of receiving impressions from external objects, and of generating the nervous power, are two orders of nerves; whose distinct characteristics were first pointed out by Sir Charles Bell. It is the office of one of these orders of nerves to transmit the impressions to the nervous centres, and of the other to serve as a medium for the exercise of the nervous power upon all parts of the body. This combined function establishes the more complex one of sympathy, or reflex nervous action.

463, *a*. The foregoing anatomical discovery only establishes what was before known of the laws of sympathy by accurate observers of nature. The general attributes of sympathy were understood by Hippocrates, and were at the foundation of no small part of his medical philosophy and practical habits. From the origin of medicine to the present time the subject has engaged the attention of the medical world. Its important outlines were originally drawn from the vital phenomena alone. We learn from Plato, a cotemporary of Hippocrates, that the general doctrine of sympathy, in its application to the cure of disease, was considered fundamental by physicians. Thus: "Occulorum morbosos affectus sanari non posse, nisi prius curetur caput, neque caput nisi prius curetur corpus, neque corpus sine animo, aiebat medicus quidem apud Platonem." Galen writes of it.

463, *b*. When the nervous system became understood, this knowledge aided greatly an analysis of the laws of sympathy. "Glisson, in 1677, speaks of an influence being '*reflected*' from one nerve at its origin upon other nerves, so as to cause consensual movements." Unzer, in 1771, was close upon Bell's discovery, and Whytt and Monro also carried on the inquiry in conformity with the designs of structure. In 1784, Prochasca established the theory of reflex action of the nervous system. This great theory has been recently analyzed and reduced to a system of magnificent laws by Professor Müller, to which Dr. Hall and others have also made some contributions.

464. But, the present century contributes to medicine a discovery which lays open the precise mechanism that subserves the laws of sympathy. It consists, essentially, in having demonstrated the two orders of nerves (§ 462). With this mechanism, in its connection with the phenomena of sympathy, we move forward with unerring certainty to the exposition of principles and laws which are as peculiar to organic beings as their structure and results, and as determinate as the mechanism is replete with consummate Design.

465. The posterior roots of the spinal nerves, which have a ganglion upon them, denote the part appropriated to sensation, or to such impressions as may be transmitted from the periphery to the centre. The anterior roots, which are without a ganglion, exercise the motor function, and that range of influences upon which all the immediate and important results of sympathy depend (§ 226, &c.). The fibres of these roots are gathered into bundles, forming the nerves, and are thus distributed to various well-known parts; and what is of the high

est moment in organic life, and mainly important to the purposes of these Institutes, these nerves contribute to the great sympathetic (§ 111–117, 129, 500 *e–m*, 514 *c*, *d*, 515, 520, 891½ *g*, *k*, 893 *a*, *c*, 1037 *b*).

466. The motor and sensitive fibres of a common nerve do not unite, but are even distributed separately in the organs which they supply.* They have, therefore, no action upon each other except through the nervous centres. The phenomena, at least, declare it.

467. All the late anatomical investigations of the spinal cord by Stilling, Van Deen, Budge, and others, go to confirm the foregoing conclusions (§ 465, 466). They have also probably indicated the anatomical mediums, in the spinal cord, by which impressions are conducted to the brain, and influences transmitted from that organ. Stilling, for instance, supposes that the longitudinal fibres of the posterior gray substance of the cord transmit the sensitive impressions to the brain, and that the longitudinal fibres of the anterior gray substance are the medium through which the will operates in voluntary motion.—*See* § 1037 *b*.

468. The foregoing discovery has led to the knowledge that one of the functions of a nerve may be destroyed without impairing the other. If the posterior root be paralyzed or divided, sensation is destroyed, but not the power of motion. So, on the other hand, if the anterior root be divided or paralyzed, voluntary motion is destroyed, but not sensation; and, as organic motion is independent of the will, it is only influenced, not destroyed, by this injury of nerves (§ 205–208, 226, 257, 500).—*See later observations*, § 1037 *b*.

469. The two orders of nerves occur in the great sympathetic, and appertain, also, to those nerves which proceed directly from the brain, where they are either compounded, as in the spinal nerves, or make up, respectively, distinct nerves of sensation and motion.

Those which proceed from the brain are distributed into three classes:

1st. "Nerves of special sense; namely, the olfactory, optic, and auditory nerves.

2d. "Mixed nerves with the double roots; the trigeminus, glossopharyngeus, (?) and the par vagum with its accessory, and, in several mammalia, the hypoglossus.

3d. "Single-rooted nerves, for the most part of motor function, which are either themselves entirely motor, and receive sensitive fibres from other nerves, or which, if their roots contain sensitive fibres, still cannot be classed with the double-rooted nerves. These are the occulo-motorius, the trochlearis, the abducens, and the facial nerve."—MÜLLER.

470. The nerves of the sympathetic system are exquisitely endowed with that modification of sensibility which I have denominated sympathetic sensibility (§ 201–203, 451, &c.). This modification is not less strongly pronounced in the sympathetic system than specific sensibility in the nerves appropriated to the organs of sense; for it is through this medium that all the organic viscera "feel," as it were, the condition of each other.

The nerves of the ganglionic system have only an involuntary motor influence upon the parts to which they are distributed.

"It being shown that the sympathetic regularly receives fasciculi of motor and sensitive fibres from the spinal nerves, as their motor

* This is inferable from the phenomena, and *from these the laws are deduced* (§ 131, 990½ *c*).

and sensitive roots, the existence of a similar relation between it and those cerebral nerves which are analogous to the spinal nerves, in having double roots, becomes very probable."—MÜLLER.

Laws of the Action of Motor Nerves of the Cerebro-spinal System.

471. 1. "The motor influence is propagated only in the direction of the nervous fibres going to the muscles, or in the direction of the ramification of the nerve; and never in a retrograde course."

2. "The application of mechanical or galvanic irritation to a part of the fibres of a nerve does not affect the motor power of the whole trunk of the nerve, but only of the insulated portion to which the stimulus is applied."

3. "A spinal nerve entering a plexus, and contributing with other nerves to the formation of a great nervous trunk, does not impart its motor power to the whole trunk, but only to the fibres which form its continuation in the branches of that trunk."—MÜLLER.

Laws of the Action of Sensitive Nerves of the Cerebro-spinal System

472. 1. "When the trunk of a nerve is irritated, the sensation is felt in all the parts which receive branches from it. The effect is the same as if all the ultimate ramuscules had been irritated."

2. "The sensation produced by irritation of a branch of a nerve is confined to the part to which the branch is distributed, and generally, at least, does not affect the branches which come off from the nerve higher up, or from the same plexus."

3. "When, in a part of the body which receives two nerves of similar function, one is paralyzed, the other is inadequate to maintain the sensibility of the entire part. On the contrary, the extent to which the sensibility is preserved corresponds to the number of the primitive fibres unaffected by the lesion."

4. "When different parts of the thickness of the same nerve are separately subjected to irritation, the same sensations are produced as if the different terminal branches of these parts of the nerve had been irritated." The sensations, however, are greatly less in the former instance (§ 826, *d*).

5. "The sensations excited in the minute elementary fibres are transmitted from the surface of the brain, without being communicated to the other fibrils of the same nervous trunk."—MÜLLER.

The foregoing laws are relative to specific sensations, and are more or less applicable to sympathetic sensation (§ 450, 451).

Of the Spinal Cord.

473, *a*. 1. "In a physiological point of view, the spinal cord so far agrees with the nerves that it propagates actions of the nerves, which enter it, to the brain, just as the cerebral nerves communicate impressions made on them immediately to the sensorium commune; and that it communicates the influence of the brain to the nerves arising from it, which thus receive, through the medium of it, the cerebral influence, just as if they arose from the brain itself. In other respects, however, the spinal cord differs essentially from the nerves in possessing properties which belong to it as a part of the central organs, and do not reside in the nerves (§ 459).

2. "All the cerebral nerves are immediately subject to the influence of the brain, and all the spinal nerves are subjected to the same influence through the medium of the spinal cord. As soon as the transmission of this influence is interrupted, impressions on sensitive nerves cease to be propagated to the sensorium, and the brain loses the power of voluntarily exciting the motor action of the nerves which are withdrawn from its influence. When the communication of the brain and spinal cord with the nerves is interrupted by wounds, pressure, or paralysis, all the branches which are given off below the affected spot cease to be voluntarily excited by the motor action; and the action of external stimuli on the same parts produces no sensation.

473, *b*. "Those branches, on the contrary, which come off from the nerve above the point of injury are still subject to the influence of the brain and of volition, and, when irritated, give rise to sensation."

473, *c*. "The parts of a nerve below the injured point preserve, however, their motor power for a certain time. It is merely the influence of the brain upon them that is lost. The nerve does not lose its excitability to external agents until it has been several months cut off from intercourse with the brain" (§ 459 *c*, 461).

In organic life impressions may still be propagated to and from the brain upon parts situated below the point of interruption, through the sympathetic nerve, and although there be no other medium of communication than by the connection of the sympathetic nerve with the blood-vessels. This is an important consideration in forming conclusions from certain experiments upon the nerves, with a view, in part, to ascertain the modus operandi of morbific and remedial agents in their action upon organs distinct from each other.

3. "In man and the higher animals the spinal cord stands in the same relation as all the cerebral nerves to the brain. It is to be regarded as the common trunk of the nerves of the body; although it is, besides this, distinguished by special properties."

4. "The fibres of the spinal cord pass through the medulla oblongata to reach the sensorium commune. All the primitive fibres of the nerves terminate in the brain; those of the cerebral nerves immediately, those of the spinal nerves through the medium of the spinal cord."

5. "The spinal cord has the property of reflecting irritations of its sensitive nerves upon the motor nerves, but without itself perceiving the sensation" (§ 201–204, 451 *d*–451 *f*, 1037 *b*).

"The spinal cord, even when separated from the brain, and without any external stimulus, can excite automatic movements."

6. "The spinal cord, although capable of exciting the motor nerves to automatic actions, nevertheless, in the healthy state, leaves a great part of the motor nerves, those supplying the muscles of locomotion more especially, in a quiescent state; while on others it exerts a constant motor influence (§ 500, *k*). It thus maintains constant involuntary contractions, which are arrested only by the spinal cord becoming paralyzed. The motions of this kind are, 1st, those of muscles which are also subject to the influence of the will, as the sphincter ani; 2d, those of muscles not subject to the influence of the will, as the sphincter vesicæ urinariæ, the muscular coat of the intestines, &c."—Müller. Those muscles may be affected by the will (§ 500 *e*).

474. 1. "The activity of all the special functions of the nerves is

determined by the central organs, partly under the influence of the mind, and partly independently of this influence."

2. "The central organs connect all the nerves into one system. To this even the sympathetic nerves do not form an exception."

3. "The central organs are the exciters of the motor nerves which conduct the motor influence of the nervous principle to the muscles. This motor influence may be constant, as we see in the case of the sphincters; secondly, it may be evidenced in intermittent rhythmic movements, such as those of respiration; and, thirdly, the motor influence may issue voluntarily from the *sensorium commune* (the part of the brain on which the mind acts) to the central organs; this sensorium commune being subject to the spontaneous actions of the mind.

"The motor nerves are affected by this motor influence in two ways. First, the nerves of one class act as mere conductors of it. In their normal state they do not exert this power spontaneously, but only when excited by the central organs. These are the motor nerves of the cerebro-spinal system.

"Secondly, the nerves of the other class, which are quite withdrawn from the influence of the *sensorium commune*, as far as regards voluntary actions [not the passions], are likewise capable of being excited to *constant* and *periodical* action by the central organs. But they present the peculiarity of affording independent discharges of the nervous influence; although, after a time, communication with the central organs is found to be necessary for the production of the nervous power. Such are the sympathetic nerves with regard to their motor actions."

The first of the foregoing varieties of motor influence is the exciting cause of voluntary motion. By the second I interpret, mostly, the operation of morbific and remedial agents upon parts not immediately connected with the direct seat of their action, and the phenomena of sympathetic diseases, and other sympathetic results among separate parts.—See RIGHTS OF AUTHORS p. 912.

The former part of the next following law, and § 473 *c*, no. 5, have led me to distinguish the third kind of sensibility and sensation, which I have denominated sympathetic (§ 201–204, 451). Thus:

4. "Impressions conveyed by the sensitive nerves to the central organs are either reflected by them upon the origin of the motor nerves, without giving rise to true sensations, or are conducted to the sensorium, the seat of consciousness."

5. "The nervous influence is generated in the central organs." This is not universally true, since "*The maintenance of the excitability in the nerves does not, however, depend solely on the continuance of the influence of the central organs on them, but also upon their own activity.*"—MÜLLER.

It is still a problem whether the "activity" of the nerves here spoken of be not equivalent to a partial production of the nervous power. There are many facts which appear to denote a low degree of this office (§ 224, 461, 497).

475. It remains now to say, under the present section, that it is important that the hypothetical words *motor* and *sensitive*, and *senso-motory*, do not betray us into the belief that the nerves are the causes of motion, or that there is any sensation connected with the organic phenomena of sympathy (§ 201–215, 257, 222–233, 451). The term "*excito-motory*" is far preferable to *motor;* and *sensitive* it might be difficult to improve The term *reflex* involves profound philosophy.

475½. Although the nervous power is the only immediate exciting cause of voluntary motion (§ 258), the mind is a remoter cause (and therefore a substantive agent), and so far voluntary motion is on common ground with motions in organic life, where, for example, the blood is the remote exciting cause for the heart and blood-vessels, food for the intestine, acting upon their lining tissues (§ 136), while the nervous power, by reflected action, is the stimulus for the muscular tissue in natural states. But all muscles may be made to act by other stimuli (§ 243–246, 476 *c*, 498 *e*, 500 *m*, *o*, 514 *f*, 647½, 1042).—Note A.

III. Experiments to determine the Laws of the Vital Functions.

1st. *On the Principle on which the Action of the Heart and Vessels of Circulation depend.*

476, *a*. I now come to certain important experiments by different observers, especially by Dr. A. P. Wilson Philip, as contained in his work on the Laws *of the Vital Functions*. It was the main object of those experiments to demonstrate the independence of organic functions of the nervous system; to show that those functions arise from the organic properties (§ 183, &c.); and they are perfectly triumphant. They have been often repeated, and their results as often verified. It may, therefore, be thought that a simple reference to those results would answer the objects of the present work. But, an age of materialism requires a constant appeal to the senses, as the only recognized mode of reaching the understanding (§ 234, 350¾ *k*); and, I have in view not only the great original objects of those experiments, but what is still more practically important, and peculiar to myself, the application of the laws of the nervous system which they illustrate to the operation of morbific and remedial agents, having especially employed them for the last purpose to demonstrate the philosophy of the operation of loss of blood, in the *Medical and Physiological Commentaries*, vol. i., p. 161–173, &c. The experiments show us how it is that morbific or remedial agents, when applied to a part, may develop and modify the nervous power, and reflect it with various effect upon other parts (§ 226). They also place all the processes of living beings upon purely vital grounds; even the vegetable kingdom, by the force of an incontrovertible analogy (§ 1041.—Also, Rights of Authors).

476, *b*. Prior to the time of Haller, the nervous power was considered, in one way or another, as indispensable to the motions of the heart, and the brain was the seat to which the power was referred. Whytt had just before laid the foundation for rejecting the supposed necessity of the nervous system to organic life. Haller then took up the inquiry, and carried it forward by a multitude of experiments, and overthrew the doctrine of the necessity of the nervous system to organic actions (§ 167). The experiments of Philip confirm those of Haller, while, also, they are more conclusive. But he is entitled to the greater credit of demonstrating, experimentally, that organic actions are influenced by the nervous power, although it was clearly known to Whytt, Haller, and Prochasca, that such an influence obtains; while Haller, like Philip, separates it entirely from the natural relations of the nervous system to the organic functions. Prochasca, also, had ascertained, near the close of the last century, about all that is now more distinctly known of the doctrine of reflex nervous

action, or remote sympathy; but the nature of the principle, and the remarkable distinction in the constitution of the anatomical medium, were not shown till demonstrated by the experiments of Bell and Philip (§ 462–469). Hunter, reasoning upon the natural phenomena of healthy and morbid conditions, contributed largely to the inquiry Bichat followed immediately after, and pointed out the natural distinction of the two lives, analyzed the tissues (§ 86–88, 96–101), and developed, more than his predecessors, the nature of the vital properties, and construed all the phenomena of life, healthy and morbid, by the normal and abnormal states of the properties of life.

476, *c*. It has been a question of difficult solution, how the passions should affect so sensibly the actions of the heart, while the will has no influence upon this organ. And so of all other organic viscera. This problem I have explained by showing that the will is a distinct element of the mind, as the passions are equally distinct. One determines the nervous power upon the voluntary organs, the other upon the involuntary; each having their great, specific, final causes (§ 188½ *d*, 205–208, 226, 233, 481 *b*, 486, 487, *k*, 492, no. 7, 500 *d–k*, 951). In the latter respect, the passions are exactly analogous to the influence of morbific or other foreign agents that may operate either directly or indirectly upon the brain; being, like those agents, capable of modifying the nervous influence in its relation to the actions of organic life, while the will is incapable of such modifying effect upon the nervous influence in its relation to the actions of animal life (§ 226–228, 233, 500 *d–k*). The principle depends greatly upon the fact that the will limits the nervous influence to cerebro-spinal nerves (except § 500 *dd*, *e*), while mental emotions act chiefly through the sympathetic (§ 500 *g*, 893 *a*, *c*, 893½, 1067, 1072 *b*).*

476½, *a*. The researches of Le Gallois upon the influence of the medulla oblongata and the spinal cord on organic actions led immediately to those by Wilson Philip, and others who embarked in the same inquiry. Le Gallois very happily analyzed the relations of the me dulla oblongata to the respiratory function, and the various movements of the process, and showed that it was the most mortal part of the body, by its immediate control over that function. The subsequent discoveries of Sir Charles Bell as to the sensitive and motor nerves have shown, also, that it is in the medulla oblongata that the nervous respiratory influences have their centre.

476½, *b*. Le Gallois' experiments upon the spinal cord, and his inductions from them, and as sanctioned by others, are remarkable exemplifications of the fallacies to which results, artificially obtained, may conduct us, and supply a forcible illustration of the propensity of the mind to grasp at a single fact, and to draw important conclusions from it, to the exclusion of all others, however contradictory. It is mainly, however, as to the supposed dependence of the functions of the heart, intestines, and other organic viscera, upon the spinal cord, that these errors relate. A general summary of the observations will aid the inquirer after the philosophy of this subject. I am the more induced to present this outline from the misapprehensions which continue to surround the subject, even in the ranks of the most erudite physiologists. Thus, Dr. Marshall Hall, in his late *Memoir on the Nervous System* (1841), inculcates the following doctrines: "*The spinal marrow*," says Dr. Hall, "*exclusive of the cerebrum, is the* SOURCE

* Also my work on the SOUL AND INSTINCTIVE PRINCIPLE, edition 1870.

of animal life."—"*The* IRRITABILITY *of the muscles of organic life depends, probably, on the ganglionic system*" (§ 188–193. Also, my Essay on the *Modus Operandi of Remedies*, p. 42, in *Med. and Phys Comm.*, vol. iii.).—§ 1041.

476½, *c*. Such were the results of the experiments, and such their novelty, that, having led their author to the conclusion that the functions of the heart, and other organic viscera, depend upon the nervous power of the spinal cord, the doctrine was received with éclat by the French Institute, and, indeed, by all Europe, in defiance of the well-known fact that fœtuses have been born alive without brain and spinal cord, that the heart will palpitate for hours after its removal from the body, that the intestines will roll about upon the table, when air and injuries, not the nervous power, are exciting causes. They simply took, as the ground of their conclusion, the safety of excision of the brain, or of its removal from the cranium, contrasted with the destructive effects of crushing the spinal cord (§ 456, 461½ *a*, 490, 498 *e*).

476½, *d*. The foregoing conclusion was inferred from the interruption of circulation by destroying the spinal cord by a wire thrust down the spinal column. The action of the heart, however, was not wholly arrested; but it failed to circulate the blood in the large arteries. This was supposed to be owing to a privation of the nervous power, by which the heart became enfeebled. Le Gallois also supposed that the actions of the heart were irregularly performed, which was also an error.

Next, he destroyed only small portions of the spinal cord, and the results led to the conclusion that it is not from the whole spinal cord that every part of the body derives its organic life, but from that part of it only from which the nerves are supplied. And, although this philosophy is wrong, the conclusion is right, that in destroying any particular part of the spinal cord, we only impair life in those parts of the body which correspond to that part (§ 507–510).

476½, *e*. Now, although rabbits twenty-two days old have no difficulty in living for some time after the head is cut off, yet the fact was ascertained that the destruction only of the spinal cord destroyed life, at that age, in less than four minutes; respiration ceasing first. This experiment, especially, led to the belief that the principle of life upon which the heart depends resides in the spinal cord.

Le Gallois next ascertained that the destruction of either the dorsal or cervical portion of the spinal cord was fatal to rabbits of the foregoing age, even in a shorter time than that of the lumbar portion; that is, in about two minutes. The results, however, as to time, varied at different ages; and death took place soonest in parts that were opposite to the portion of the cord destroyed.

Now this sudden abolition of life, from a partial destruction of the spinal cord, was imputed by Le Gallois to the loss or extinction of the circulation; and this, regarded as a remote result, was in part true. But, as will have been seen, the immediate and essential effect consisted in the destruction of the organic properties of the heart and blood-vessels, by determining upon them, and all other parts embraced within the compass of experiment, a pernicious nervous influence by the sudden destruction of the spinal cord (§ 226, 227, 510) It also appeared to follow (and such was the conclusion), that the power, on which the motion of the heart depends, resides in the whole

of the spinal marrow; since the destruction of either cervical, dorsal, or lumbar portion, arrested the circulation. But here, again, we see the error of the conclusion; since a fatal nervous influence would be equally propagated upon the heart, not only through the continuous parts of the spinal cord and brain, but through the sympathetic nerve, by destroying any one of the three portions of the cord, and this, too, without the heart being intrinsically dependent for its motions upon any part of the spinal marrow (§ 458, 459).

476½, *f*. Such, however, was the effect of the foregoing influence upon the powers of the heart; and, as the blood-vessels are, also, prostrated in their action by the same cause, it is obvious, if the extent over which the blood circulates be lessened in proportion as the heart is enfeebled, the circulation will be prolonged in parts corresponding with the portions of the spinal cord that are not destroyed. It is only necessary, therefore, to apply ligatures around the principal arteries, to answer the intention. Hence, rabbits live much longer if the aorta be tied near its emersion from the diaphragm, before destroying the respective parts of the spinal cord. By the same rule, also, if the head be cut off, before destroying the cervical portion of the spinal marrow, life is supported much longer than when the head is on.

476½, *g*. It appears, therefore, that death resulted in Le Gallois' experiments partly from the propagation of the nervous power upon the vital properties, not only of the heart, but of all the organic viscera, and in part, also, by withdrawing the regulating medium of concerted actions, and thus deranging the organic relations (§ 129, 455, 510).

476½, *h*. Le Gallois found, to his surprise, and beyond his explanation, that if the spinal cord be slowly destroyed, the effects were greatly different from such as resulted from its sudden destruction; that is to say, the circulation was at once arrested when the cord was suddenly destroyed, but not so when gradually destroyed. This fact, in itself, is subversive of his principal conclusions; and the difference in results depends upon the greater violence of the nervous power when suddenly, than when more slowly excited (§ 479). This is also shown in paroxysms of joy and anger. These passions may kill on the instant, if suddenly excited, but never when gradually produced, whatever their ultimate intensity (§ 230). So a blow upon the region of the stomach, which shall not exceed in force ten pounds, may destroy life instantly, when a weight of one hundred pounds, gradually applied, may be wholly innoxious (§ 509). This is a very important law of the nervous influence, as it is in constant operation in the production and cure of diseases, whether the effects depend upon physical or mental causes. It is owing to the suddenness with which the nervous power is developed, that syncope may be occasioned by a very small loss of blood (§ 940, 961, 974), or when it proceeds from offensive sights, nauseous odors, or any mental emotion (§ 944). It is owing to the same principle, in part, that blisters often give more relief when they operate rapidly than slowly. It is an especial reason why emetics are often so suddenly curative in croup, &c.; all having their astonishing foundation in a common principle (§ 893 *i*, 902 *g*).

477, *a*. I now approach the important experiments which overthrow Le Gallois', and all the conclusions which were so extensively derived from them as to organic actions, and through which, in part, I

interpret all the laws of remote sympathy, all the effects of morbific and remedial agents upon distant parts when applied to the stomach, or skin, or lungs, &c.; of the remote influences of disease, and all the effects of the passions; of blows upon the epigastrium, and the suddenly pernicious influences of surgical operations; in short, every unusual phenomenon which can be supposed to happen through the agency of the nervous power. It will be seen, also, that they corroborate, and are corroborated by, all the conclusions which I shall have drawn as to the nervous power, and its laws of reflex nervous action, from the phenomena of natural and morbid conditions, and from the discoveries in relation to the two orders of nerves (§ 464).*

Unless otherwise stated, the experiments are by Philip. A large number are omitted, as unnecessary to my purposes.

477, *b. Experiment* 1. "A rabbit was deprived of sensation and voluntary motion by a blow on the occiput. Respiration ceased, but was kept up artificially. The spinal marrow was then laid bare from the occiput to the dorsal vertebræ. The chest was next opened, and the heart was found beating with considerable force. The whole cervical portion of the spinal marrow was then removed, and without affecting the action of the heart. The skull was then opened, and the whole brain removed, so that no part of the central organs remained above the vertebræ. There was, however, no abatement of the action of the heart. By suspending artificial respiration, however, about an hour and a half after the removal of the brain, the heart ceased to beat; but its action was again restored on renewing the respiration; that is, on receiving *oxygenated* blood.

Exp. 2. "Having rendered a rabbit insensible by a blow on the occiput, Philip destroyed the whole spinal marrow by a hot wire. Respiration was supported artificially, and, on dividing the carotid artery, the blood spouted out.

Exp. 3. "A rabbit was rendered insensible by a blow on the occiput, and artificial respiration performed. The spinal marrow, from the base of the skull to the beginning of the dorsal vertebræ, was removed, and the remaining part of it was destroyed by a hot wire. The carotid artery was then found beating, and, on dividing it, the blood rushed out with great force, *per saltum.*

Exp. 4. "In another rabbit, insensibility was produced in the foregoing manner, the whole spinal marrow removed, and artificial respiration not performed. The carotid artery being divided, dark-colored blood flowed *per saltum.* The lungs were then inflated, and florid blood began to spout out of the artery.

Exp. 5. "In this experiment the rabbit was rendered insensible, but not motionless, by a blow on the occiput, and natural breathing continued. The spinal cord was then destroyed by a hot wire. A femoral artery was now opened, and the blood spouted out. Then the other femoral artery was opened, from which the blood flowed copiously, and continued to flow for seven minutes; when one of the carotids was opened, from which blood issued in a full stream, and till most of the blood was evacuated.

Exp. 6. "The brain of a frog and the spinal marrow, as low as the dorsal vertebræ, were laid bare. The thorax was then opened, and the heart found acting vigorously. The part of the spinal marrow which had been laid bare was then removed, but without at all affect-

* See RIGHTS OF AUTHORS p. 912.

ing either the motion of the heart, or the passage of blood through it. The brain was then removed with the same result.

Exp. 7. "The brain and spinal marrow of a frog were removed at the same time. On opening the thorax the heart was found performing the circulation freely.

Exp. 8. "A ligature was applied to the neck of a frog, the head cut off, and the spinal marrow destroyed by a wire. The circulation in the web continued afterward, for many minutes, as vigorous as in that of a healthy frog.

Exp. 9. "The spinal marrow and brain of a frog were destroyed by a wire. The animal appeared quite dead for several minutes, during which the circulation was seen in the web as vigorous as in that of a healthy frog."

478, *a*. The foregoing and following experiments disprove the conclusions derived from Le Gallois', that the power, on which the motion of the heart depends, resides in the spinal cord, and in all parts of it. They also establish, what had been sufficiently shown by the heart when severed from the body, that its action may be continued without brain and spinal cord; and the proof extends equally to the blood-vessels. "From various trials," says Dr. Philip, "we found that the circulation ceases quite as soon without, as with the destruction of the spinal marrow. Loss of blood seems to be the chief cause." "The result is still more striking in cold-blooded animals, in which death takes place so slowly that the circulation continues long after the total destruction of the brain and spinal marrow" (§ 257).

478, *b*. The experiments prove, what will be more fully shown, that, to influence the heart and vessels through the main nervous centres an impression must be made either upon the brain or spinal cord. But the sympathetic nerve, with its central ganglia, was present, by which an exciting influence was propagated upon the great organs and blood-vessels; and however the heart and intestines may be maintained in muscular action when severed from the body (§ 264), the whole nervous mechanism, especially the ganglionic, is engaged, in natural states, in reflecting exciting influences upon those organs, the blood-vessels, &c., and thus, also, modifying the organic products (§ 113, 356 *a*, 399, 456 *a*–459 *g*, 461, 473 *c*, 475½, 476 *c*, 483 *c*, 889 *g*, 952).*

478, *c*. The experiments prove, in connection with others to be related of the same nature, that the actions of life are carried on by powers or properties inherent in each part (§ 184).

478, *d*. They prove that when death suddenly follows a division of the medulla oblongata, or a simple removal of the brain and spinal cord, it does so essentially by abolishing respiration, or rather as in § 510.

479. A practical consideration of great moment grows out of the difference in the modes in which the foregoing experiments were performed by Philip and Le Gallois, and the vast difference in the results. The discrepances in results were owing entirely to a difference in the size of the wires by which the two experimenters destroyed the spinal cord; Le Gallois having employed a wire that filled the cavity of the spinal column, and thus destroyed the spinal cord suddenly, while Philip used a smaller wire, and destroyed the cord gradually; or it was removed, along with the brain, without farther injury to them. In Le Gallois' experiments, therefore, the nervous influence was suddenly and powerfully transmitted through all the nerves leading from

* See late *Experiments* with poisons, NOTE B p. 1113.—1862.

the spinal cord, as well as the sympathetic; while in l'hilip's, it was so gradual and imperfect, that it was not determined with destructive violence upon the organic properties of the heart and blood-vessels, though always with a more or less prostrating effect at first. So, too, of the sudden or gradual destruction or removal of the brain. What, also, is thus true of the heart and blood-vessels (as will farther appear), is equally so of all the other organic viscera (§ 476½ *h*, 509, 510, 947).

2d. *On the Relation which subsists between the Heart and Vessels of Circulation, and the Nervous System; and the Influence of the Nervous System upon the Capillary Blood-vessels.*

480. The following experiments are much more important than the preceding in ascertaining the existence of the nervous power, how it may be variously excited, how variously modified by artificial causes, and how it may be determined with various effects upon the organic functions. These, with another group relative to the stomach and intestines, open to us the modus operandi of the passions in organic life, of morbific and remedial agents in their effects upon parts distant from the direct seat of their operation, of sudden deaths from injuries distant from the nervous centres, of the sympathies from diseases, &c.; when taken in connection with what is known of the sensitive and motor nerves, and the reflections of the nervous power, as set forth in the laws relative to this subject (§ 462–470, 512–524).

The object in producing insensibility was to prevent all agitation of the animals, that the effects of the stimuli, &c., might be most advantageously observed.

Experiments relative to the Heart in its Connection with the Nervous System.

481, *a. Experiment* 10. A rabbit was deprived of sensation and voluntary motion by a blow on the occiput, artificial respiration performed, and the brain and cervical part of the spinal marrow laid bare. The thorax was then opened, and the heart observed to beat with strength and regularity. *Spirit of wine* was then applied to the spinal marrow, and a *greatly increased* action of the heart was the consequence. It was afterward applied to the brain with the same effect. The increase of action was immediate and decided in both cases, and as great in one as in the other. The effect of the *blow* upon the head, in all the cases, was to *lessen* the frequency of the pulsations; as generally happens in apoplexy.

Exp. 11. The foregoing experiment was repeated, with the difference, that the whole of the spinal cord was laid bare. The motion of the heart was nearly, if not quite, as much influenced by the application of the alcohol to the dorsal, as to the cervical portion of the spinal marrow; but it was very little influenced by its application to the lumbar portion.

481, *b.* We see, therefore, that experiments 10 and 11, independently of the more important ones which follow, illustrate the most essential elements that are concerned in remote sympathy, and in the operation of the passions upon organic actions, in their connection with what has been said of the sensitive and motor nerves and their relations to each other (§ 462–475). When, for instance, a morbific or remedial agent, applied to the stomach or skin, influences a remote

part, and produces, or removes, disease in that part, its primary impression is transmitted to the brain and spinal cord by the sensitive nerves, where the impression acts upon the central organs just as the alcohol did in the foregoing experiments, and, like that, it develops the nervous power which is then reflected through the incident nerves upon remote parts, just as it was to the heart in the application of the alcohol; the incident nerves in organic life being the sympathetic.

As to the passions, they are exactly equivalent to the action of agents applied directly to the brain, and develop and modify the nervous power in the same direct manner. Such as are exciting are analogous in their effects to those of alcohol; such as are depressing, to those of tobacco, opium, &c. (§ 227–230). From the equal effect of the alcohol, also, when applied directly to the spinal cord, it is evident that the nervous power is also generated in this part, as it is, more or less, in all the nerves.

When, however, the nervous influence is developed by the primary action of alcohol on the stomach, and the action of the heart is increased in consequence, the development of the nervous influence is reflex; just as it is in respiration (§ 500). But, in all these cases, the nervous influence is developed in the brain and spinal cord by the transmitted impression, just as it is by the alcohol when applied directly to the nervous centres; the transmitted impression being exactly equivalent to the direct action of the physical agent upon the central parts (§ 1074). *There is no absorption of alcohol*, p. 172, no. 94. 481, *c*. It is now important to observe in the relative experiments upon the brain and spinal cord, that when they exist in connection, the influence of agents applied to the cord, in developing the nervous power, may be mostly exerted upon the brain (§ 459, 481 *e*).

Exp. 12. "Preparation the same as in Exp. 10 and 11, excepting only the anterior part of the brain was laid bare. The spirit of wine applied to this part of the brain produced as decided an effect on the motion of the heart as in Exp. 10 and 11. The spirit of wine was washed off, and a watery solution, first of opium, then of tobacco, was applied, with the effect of an increase, but of a much less increase of the heart's action, than arose from the spirit of wine. The increased action was greater from the opium than from the tobacco. The *first* effect of both was *soon succeeded by a more languid action* of the heart than that which preceded their application to the brain. This effect was greatest and came on soonest when the tobacco was used; and there was always observed, for the experiment was frequently repeated, *an evident increase in the action of the heart when the tobacco was washed off*. This was also seen, though in a less degree, when the opium was washed off. Little or none of this debilitating effect was observed when the spirit of wine was used. After its stimulating effect had subsided, the action of the heart returned to only about the same degree as before the application of the stimulus.

Exp. 13. "The foregoing experiment was repeated on an animal of cold blood. In this case a frog was deprived of sensibility, in less than a minute, by immersing the hind legs in the tincture of opium. Alcohol, and watery solutions of opium and tobacco, were applied to the brain and spinal cord, as in Exp. 12, and with precisely the same effects. The application and *washing off* of the stimulant and sedatives were frequently repeated in this experiment with the same results.

It is remarkable that we could affect the motion of the heart by the agents applied to the brain and spinal marrow *after they had all ceased to produce an effect on the muscles of voluntary motion* through the medium of the nervous system. The action of the heart could be also influenced by these agents applied to the brain and spinal marrow *long after the circulation had ceased.*" Of course, therefore, no action by absorption.

Exp. 14. "This experiment only differed from the last in the cervical part of the spinal marrow and lower part of the brain being removed, and the agents applied only to that part of the brain which lies between the eyes of the frog. Spirit of wine, opium, and tobacco, thus applied, affected the motion of the heart quite as much, and precisely in the same way, as when they were applied to the entire brain or spinal marrow.

"The action of the heart, in the foregoing experiment, could be influenced by agents applied to the brain and spinal marrow *long after the circulation had ceased.*"—NOTE B p. 1113.

481, *d.* In Exp. 12, 13, and 14, we have an illustration of the modification of the nervous power according to the nature of the agents employed, while the effects correspond with such as are produced by the same agents when taken into the stomach (§ 226, &c.). It will be also observed that the effects are parallel with those of the different passions; those of the alcohol corresponding with the effects of anger and joy, and those of opium and tobacco with such as arise from grief, fear, &c. I hold that the doctrine which I have propounded as to modifications of the nervous power is established by these experiments; though abundantly shown by the phenomena arising from morbific and remedial agents. There is no other intelligible solution of the problems which they supply. In the experiments, too, it will be conceded that the nervous power was the efficient remote cause of the results; whence it follows that the nervous power must be in different states when it is excited by alcohol, opium, and tobacco, corresponding with the differences in effects (RIGHTS OF AUTHORS, p. 912).

481, *e.* The foregoing Exp. 12, 13, and 14, independently of the multitude of other facts, also completely refute the doctrine of the operation of morbific and remedial agents by absorption. It will be observed that in these experiments the action of the heart could be influenced by the agents applied to the brain and spinal cord "long after the circulation had ceased." This circumstance, besides its bearing upon the doctrine of absorption, shows us how the heart is roused into action, in cases of syncope, by the application of stimulants to the nose, cold to the surface, &c. (§ 945).

Exp. 15. "The spine of a rabbit was divided near the head, and the spinal marrow destroyed by means of a wire. Spirit of wine was then applied to the brain, which influenced the action of the heart as readily, and to as great a degree, as it does when the spinal marrow is entire" (p. 321, § 494 *e*, EXP.—NOTE B p. 1113).

481, *f.* This experiment demonstrates the difficulty of forming proper conclusions as to the special functions of the brain and spinal cord, and of different parts of the brain, by any experiments (§ 459, *a*). It shows, however, that the action of the heart may be as powerfully influenced through the brain when the spinal marrow is destroyed, as when it is entire. The ganglionic nerve resolves the problem.

481, *g*. I now come to those experiments which farther illustrate the principle concerned in the sudden production of death by blows on the epigastric region, surgical operations, small loss of blood, joy, anger, &c. They also go to interpret the modus operandi of morbific and remedial agents as to their rapidity and intensity, especially when taken in connection with Exp. 10–15, and others which are to follow. The effects now supposed depend on the rapidity and intensity with which the nervous power may be excited, and reflected not only upon the heart, blood-vessels, stomach, &c., but upon the brain itself, as also upon the manner in which the nervous power may be modified by the nature of the agent, as in Exp. 12 and 13.

If the head and spinal marrow of a frog be removed, the heart continues to perform its functions perfectly for many hours, nor does it seem at all immediately affected by their removal. But, we find the effect very different when the most sudden and powerful agent is applied to them. If they are even destroyed by being sliced away, the heart, after this mode of destruction, beats on as usual. But, if either the brain or spinal cord be instantly crushed, the heart feels it immediately and forcibly. Thus:

Exp. 16. "The thorax of a large frog being opened, the brain was crushed by the blow of a hammer. The heart immediately performed a few quick, weak contractions. It then lay quite still for about half a minute. After this, its beating returned, but it supported the circulation very imperfectly. In ten minutes after, its vigor was considerably restored; when the spinal marrow was crushed by one blow. The heart then beat quickly and feebly for a few seconds, and then seemed wholly to have lost its power. In about half a minute, it again began to beat, and in a few minutes acquired considerable power, and again supported the circulation. It beat more feebly, however, than before the spinal marrow was destroyed. It ceased to beat in about an hour and a half after the brain had been destroyed. In another frog, after the brain and spinal marrow had been *wholly removed*, the heart beat nine hours, gradually becoming more languid."

Exp. 17. "The foregoing experiment cannot be performed in the same way on warm-blooded animals, but it may be performed in a way equally satisfactory. In two rabbits the brain was crushed by a blow. In both the heart immediately beat with an extremely feeble and fluctuating motion. The anterior part of the brain only was crushed in another rabbit, with the same result. A strong ligature was thrown around the neck of a fourth rabbit, and at the same moment it was tightened, the head was cut off. The heart continued beating regularly, in this case, and not more quickly than in health. All the rabbits were of the same age."

Exp. 18. The following is still more conclusive:

"The anterior part of the brain of a rabbit was crushed by a hammer. No motion of the heart was perceived by applying the hand to the side. The head was cut off, about three quarters of a minute after the brain had been crushed. No blood spouted out, and very little ran from the vessels. A strong ligature was passed round the neck of another rabbit of the same age. It was suddenly tightened, and the head cut off. In this instance the heart was found beating regularly under the finger for about three quarters of a minute. At

the end of this time, the ligature was slackened, and the blood spouted out to the distance of three feet, and continued to spout out with great force, till nearly the whole blood was evacuated."

481, *h*. The last of the foregoing comparative experiments goes with others in demonstrating the error of the common opinion, that when the action of the heart and blood-vessels, or other organic functions, fail by crushing the brain, it is owing to the withdrawal of the nervous influence. But, still more conclusive is the fact that the entire brain and spinal cord may be removed without any present effect upon the actions of the heart and blood-vessels, as in Experiment 7. By this, and other considerations, I have endeavored to show that when syncope arises from loss of blood, it is not owing, as has been supposed, to the failure of the nervous influence upon the organs of circulation, but that this influence increases on the approach of syncope, is a principal cause of the paroxysm, and is actually greatest when the paroxysm is complete (§ 947, 948, and *Medical and Physiological Commentaries*, vol. i., p. 168–176).

482. The preceding experiments determine a variety of important points, of extensive physiological, pathological, and therapeutical application, and to which brief references were made. The whole should be viewed in connection, and also with such as are to follow; while a constant reference should be had to the laws of sympathy, as set forth in the fifth division of our subject.

Experiments relative to the Arteries in their Connection with the Nervous System.

483, *a*. The next important step in our inquiry is to ascertain, in a more specific manner than the preceding experiments, *how far the vessels of circulation are capable of being influenced through the brain and spinal cord* (§ 1040).

To determine the foregoing problem, it is first necessary to settle another; namely, *how far the vessels of circulation can support the motion of the blood independently of the heart.* That the small arteries possess this power in an eminent degree has been already rendered sufficiently certain (§ 392, 393. Also, *Med. and Phys. Comm.*, vol. ii., p. 145–151, 398, 422, &c.). But we now arrive at the same knowledge by another process.—Note Q p. 1122.

As a comparative experiment, Philip passed a ligature round all the vessels attached to the heart of a frog, and then *cut out the heart.* "On bringing the web of one of the hind legs before the microscope, *the circulation was found to be vigorous*, and continued so for many minutes; at length gradually becoming more languid."

Now, if the heart be allowed to remain, whatever impression made upon the brain shall suddenly diminish or arrest the circulation in the capillary arteries, will prove that these vessels, as well as the heart, may be influenced by the nervous power.

Experiment 19. "The web of one of the hind legs of a frog was brought before the microscope, and while Mr. Hastings observed the circulation, which was vigorous, Dr. Philip crushed the brain with a hammer. The vessels of the web instantly lost their power, the circulation ceasing. In a short time the blood again began to move, but with less force than natural. This experiment was repeated, with the

same result. *If the brain be not completely crushed, the blow increases the rapidity of the circulation in the web.*"

The next experiment corresponds with those of the foregoing, which denote that the effects of the nervous power upon the organic properties and functions depend upon the manner in which it is developed, modified, and reflected. Will *galvanism* explain them (§ 893 *a*)?

Exp. 20. "The spine of a frog was laid open at the lower end, and a wire, of nearly the same dimensions with the cavity of the spine, forced through it, as in Le Gallois' experiments. The circulation was found to have wholly ceased in the web of the hind leg."

Now mark the contrast when a small wire was employed; for, in another frog the spinal cord was destroyed by introducing in the same way, and moving in various directions, a wire much smaller than the cavity of the spine. The frog soon appeared to be quite dead; but the circulation in the web was found to be vigorous.

Exp. 21. "Part of the cranium of a frog was removed, the web of one of the hind legs brought before the microscope, and the circulation in it observed. The animal was now rendered insensible by the immersion of the other hind leg in laudanum. The insensibility did not in the least affect the circulation in the web before the microscope. Spirit of wine was then applied to the brain with an ev ident increase of the velocity of the blood in the web. The same effect was produced in a less degree by watery solutions of opium and tobacco. After the tobacco had been applied for about half a minute, the motion of the blood was much less rapid than before its application. *On washing off the tobacco, the velocity of the blood was increased, and was again lessened on applying it.* This was repeated several times with the same effects. When the circulation in the web had almost ceased after the tobacco had been washed off, *its velocity was increased on applying spirit of wine to the brain.*"

Analogous experiments, but varied from the foregoing in some of the details, gave the same results.

483, *b*. It may be proper to add, that Dr. Hall attempted to invalidate Philip's experiments with alcohol, &c., applied to the nervous centres, by repeating just *one* of them, and that one the least important of any. It was the least important because it was made upon a cold-blooded animal, and because, also, the state of insensibility was produced by laudanum; the experiment being no. 21, or the last of the foregoing series. Of that experiment he says that the motions of the heart were not affected on applying alcohol to the brain. It does not appear that he tried the effect of the infusions of opium and tobacco, nor that he repeated those far more important experiments upon warm-blooded animals.

The difference in the results is of the easiest explanation. By Dr. Hall's method of producing insensibility by the long-continued and extensive application of laudanum to the surface of the animal the sedative effect of the nervous influence was so powerfully determined upon the circulatory organs, that alcohol, when applied to the brain, failed of rousing the action of the heart. In Philip's experiment it is obvious that the cutaneous application of the laudanum was of short duration, and this was only relative to a few upon frogs. Dr. Hall, indeed, seems to have been aware that this objection might be raised against his experiment; for he remarks that, "I believe that there

may be one difference between Dr. Philip's experiment and my own (that is), I might apply the laudanum *more effectually.*" It is this difference which makes all the difference in the results (§ 484 *a*, Ex. C. D).

Finally, the force of Dr. Philip's experiment is increased by the very objection which has been made to the production of insensibility by laudanum; since his subsequent application of a watery infusion of opium to the brain influenced the heart and blood-vessels as in those cases where insensibility had been effected by other means. And so of the following like experiments by Alston, and by Dr. Hall himself.

483, *c.* There is one more fact connected with the present stage of my inquiry, which it may be well to consider, and by which Dr. Hall would invalidate, still farther, the conclusion drawn by Dr. Philip from his experiment of crushing the brain. In this experiment the action of the heart is temporarily suspended. Now, Dr. Hall would argue that this suspension is not the result of any special influence exercised by the brain over the heart, during the act of violence, because the same effect will follow when the stomach is violently crushed after removal of the brain and spinal cord. Thus:

"In an eel, in which the brain had been removed, and the spinal marrow destroyed, the stomach was violently crushed with a hammer. The heart, which had previously beat vigorously sixty times in a minute, stopped suddenly and remained motionless for many seconds. It then contracted; after a long interval it contracted again, and slowly and gradually recovered an action of considerable frequency and vigor."

Dr. Hall, therefore, argues that the nervous system had no agency in transmitting influences of the injured stomach to the heart, and that, "the organic structures (meaning others than the nervous) must have been the medium through which the effect of the violence was conveyed to the heart."

I need not go far to indicate the capital error of Dr. Hall's conclusion, so opposed to the phenomena of the passions, and the well-known effects of cerebral hemorrhage, and blows upon the head. It is sufficient, notwithstanding the removal of the brain, and the destruction of the spinal cord, in the case of the eel, that the whole ganglionic system, all the spinal nerves, and the pneumogastric besides, remained entire. It was therefore through this vast range of most important nerves, through the great solar plexus of the sympathetic, through the whole of the *anancephalous* system of nerves (§ 461½), that the nervous influence was propagated to the heart by crushing the stomach of the animal. Had, however, the brain and spinal cord been permitted to remain, the demonstrations of nervous influence upon the heart would have been more strongly pronounced. Nor was it a fair experiment to have selected a cold-blooded animal, and so tenacious of life as the eel, to contrast an important result with such as had been obtained by a very different experiment upon a warm-blooded animal.—Note B p. 1113.

But, as I have said, slight blows over the stomach of *a man* may destroy his life in an instant, when they would be harmless to an *eel.* Hunter, and others, relate instances of instant death when extirpating a testicle, or performing minor operations; and Mr. Travers, and others, from lancing a thecal abscess of the finger, and other similar

slight causes. Here, it cannot be denied, that a fatal nervous influence was thus reflected over the whole frame of *a man*, without calling to the explanation "the ten thousand" facts that are well established as to the influence of the nervous power upon organic actions; while we thus arrive at the obvious conclusion, that it is through the same principle blows upon the epigastrium, crushing the liver, and similar injuries, produce their fatal effects.

But, if we concede to Dr. Hall the inconsistency in which he is involved by his experiment, and by his direct affirmation that sympathies in organic life are owing to the mutual influences of organs among each other, and without the agency of the nerves with which they are supplied, it would not affect the principle which relates to sympathy in its aspect of an important law which is constantly concerned in disease and in the operation of remedial agents. The dispute would then turn only on the nature of the cause upon which the function of sympathy depends; while the very cases of disease which Dr. Hall produces to illustrate the existence and nature of the principle are fatal to his humoral hypothesis, and go to my doctrine of reflex nervous action.

But the accuracy of all Dr. Philip's experiments has been fully ascertained by numerous physiologists.

484, *a*. I shall now introduce a series of experiments by other hands which illustrate, still farther, the applicability which I have indicated as to the preceding experiments.

In the Edinburgh Medical Essays for 1733, vol. v., p. 128, are to be found the first experiments which I shall now mention, and which appear to have been neglected by later observers. They were made by Dr. Alston, who had no theory in view to embarrass his vision or judgment; and yet I have met with no reference to them.

Exp. A. "I conveyed," says Alston, "through a small glass tube a few drops of a solution of opium in water into a frog's stomach, and putting the animal into a glass cylinder, adapted it so to a good microscope, that we had a distinct view of a part of the membrane between the toes of its hinder foot, where the circulation of the blood may be easily seen. My design was, since I found opium killed frogs, to observe if there was any visible change made by it in the blood itself, or in its motion. Neither of us could, indeed, see any alteration of the blood as to its consistence, color of the serum, magnitude, figure, or color, of the red globules; *but we very distinctly saw a surprising diminution of the blood's velocity*, for it did not move *half so swiftly* as it naturally does in those creatures. We alternately looked at it, again and again, and in *less than half an hour saw the velocity of the blood gradually increase.* The uneasy frog recovered its wonted vigor, and the blood its common velocity."

The foregoing experiment was repeated, after awhile, upon the same frog. Alston goes on thus:

Exp. B. "I put the frog into a basin of clean water, and allowed it half an hour to refresh itself; then gave it another dose of opium. The blood then moved yet slower than it did the first time, and its velocity gradually decreasing, it at length stagnated, first in the smaller, then in the larger vessels, and in about a quarter of an hour the animal died."* The experiments were frequently repeated, with the same results.

Exp. C. The following experiment was performed by Dr. Marshall Hall:

* Whytt, in 1755, made similar experiments with the same effect.—Works, 4to, p. 310–327.—See *Note*, p. 320.

"I applied laudanum," he says, "over the back part of a frog, carefully avoiding its contact with the web. In less than half an hour, its respiration and all sensibility had ceased, and the capillary circulation became, at the same time, more indistinctly pulsatory in the arteries, and more and more slow and feeble in the capillary vessels and veins. This effect became gradually more marked, and in two hours *the circulation had ceased almost entirely in all the three sets of vessels. I now washed off the laudanum, and placed the frog in water. The circulation at first gradually, afterward more speedily, returned, and became very vivid and vigorous,* EVEN BEFORE THERE WAS THE SLIGHTEST RETURN OF RESPIRATION (§ 441, *d*). The respiration and sensibility at length also returned completely. The laudanum was reapplied and again removed *with precisely the same effects.* The *insensibility* was so perfect that the eyes were not retracted on being touched. *The recovery was prompt and complete.*"—See § 483 *b*.

Exp. D. The foregoing experiment was repeated with opium and water; when the effects were less rapid, but "at length the circulation in the web ceased, and the animal became affected with complete tetanus."

Exp. E. "The same effect was produced more speedily on inducing the animal to swallow a few drops of the opiate solution."*

484, *b*. I have now to notice six principal points relative to the experiments A, B, C, D, and E.

1st. In Dr. Hall's experiments (C and D), the opium was applied to the skin exclusively.

2d. The effects were exactly the same as obtained by administering opium by the stomach (Exp. A, B, and E).

3d. The effects in both cases were similar to those obtained by Philip from applying opium to the brain, both in cold and warm-blooded animals.

4th. The experiments by Hall and Philip fully corroborate the obvious conclusion from Alston's (Dr. Hall's being only a repetition of Alston's), that opium does not produce its effects by absorption into the circulation (as is especially supposed of this agent), since in all the experiments, and the same with tobacco in all (§ 483, Exp. 21), the effects upon the circulation went off as soon as the solutions were washed from the skin, or from the brain, and returned when they were again applied, and again promptly disappeared when the solutions were washed off. Brodie's experiment with tobacco is also in direct proof of its universal operation through the nervous centres (§ 904, *b*, 1088 *b*, *c*).†—NOTES B I pp. 1113, 1118.

5th. It appears from the foregoing facts, that the circumstances attending the effects of opium upon the system at large are the same, whether it be applied to the nervous centres, to the stomach, or to the skin. It follows, therefore, in connection with what is known of the influences which the brain and spinal cord may exert on the actions of organic life, that the remote effects of opium, applied to the stomach or skin, are produced by a modification and reflected action of the nervous power upon distant parts (§ 224, 226, &c.).

Here, then, we see, more and more clearly, the propriety of the application which I have made of Philip's experiments, and which will become more strikingly obvious by connecting them with the sequel,

* HALL, *on the Influence of the Brain and Spinal Marrow upon the Circulation*, p. 111

† WHYTT applied opium to a frog after destroying the brain and spinal cord, when the heart was much less affected than when applied in the natural state.—WORKS, p. 513.—See § 483 *c*, as to *sympathetic nerve*, and § 1088 *b*, as to *skin*.

and with the results of Sir C. Bell's discovery. Let us suppose, for instance, that we have no other knowledge of the principle upon which remote sympathy depends, than the natural phenomena which are constantly manifested. We should certainly know, from these results, that such a principle exists; but where, or how developed, or how varied in its influences, we could not know with certainty without direct experiment. With the advantage, therefore, of such experiments as Philip's, we arrive at the clearest demonstration of the manner in which effects now under consideration are brought about, and thus put an end to the worst speculations in medicine. But, before reasoning from these experiments we should know the manner in which impressions are transmitted to the brain and spinal cord by the nerves of sensation, how they are reflected from these central organs, and the obvious results which follow in animal life, and how these results correspond with similar effects in organic life (§ 500). The foundation of an important philosophy is thus laid by demonstration, and rendered acceptable to those who rely only upon the plainest testimony of sense (§ 234).

6th. Again, I say, since the action of opium, through the stomach or skin, upon remote parts, is different from that of tobacco, alcohol, &c., and since each produces, respectively, the same effects when applied directly to the brain or spinal cord, and, in all the cases, by exciting and reflecting the nervous power, it follows that this power, like the organic powers, is capable of being modified in its nature according to the nature of the causes by which it is developed (§ 224–233, 494 *c*).—Note B p. 1113.

485. Finally, Kriemer has multiplied experiments to a great extent with reference to the part which the arteries take in the circulation, and they all concur in proving their independent action, and that they may be powerfully affected by impressions made upon the nerves. When he tied the crural nerve of quadrupeds it lessened immediately the jet of blood from the femoral artery. The same experiment on frogs arrested the capillary circulation in the web of the foot. What is also an important fact as showing an alteration of the organic properties of a part by the nervous influence, he observed that the arterial blood passed on to the veins without being converted into venous blood (§ 399, 507, 952)*—Note Q p. 1122.

3d. *On the Principle on which the Action of the Muscles of Voluntary Motion depends, and the Relation which they bear to the Nervous System.*

486. Philip next proved by experiments that the muscles of voluntary motion, like the heart and blood-vessels, are independent of the brain and spinal cord, as it respects their excitability and power of motion; but that they are alike capable of being stimulated through the nervous system. "We do not, surely," he says, "in the experiments which have been laid before the reader, see any difference in the nature of the muscular power of the heart, and that of the muscles of voluntary motion, except their being fitted to obey different stimuli; a difference which we find in the two sides of the heart itself" (§ 136, 188½–190). Nevertheless, the nerves supply the *immediate* stimulus.

* This anticipates the analogous experiments which have been lately made by Cl. Bernard.—1860.

4th. *Interesting Experiments were made by Philip to ascertain the comparative Effects of Stimuli applied to the Brain and Spinal Marrow on the Heart and Muscles of Voluntary Motion.*

487, *a*. I shall state only a few of the important practical conclusions. Thus: "Another circumstance, which appears to be of great importance in tracing the cause of the different effects of stimuli applied to the brain and spinal marrow, or the muscles of voluntary and involuntary motion, is, that the heart obeys a much less powerful stimulus than the muscles of voluntary motion do. We have seen that only the most powerful chemical stimuli affect them, while all that were tried readily influenced the action of the heart and blood-vessels." This should be considered with § 493 *cc*, 500 *m*, 687½–688.

487, *b*. The foregoing shows us the distinction between the irritability of the heart and voluntary muscles, &c., how it is differently affected in organic and animal life by the same agents, how the nervous power acts upon that irritability according to the nature of the agents by which it is excited, whether they be applied directly to the nervous centres or to the stomach, &c. (§ 133–162, 188½–190, 205, 206, 208, 209, 222–233, 256, 484, 500 *m*, 826 *cc*, 893½).

487, *c*. It is also an important fact, as well in a therapeutical as physiological sense, and especially as distinguished from the action of the will and other things (§ 514 *d*), that, as the animal approached a state of death, he found that, "after all stimuli applied either to the brain or spinal cord had ceased to produce any excitement in the muscles of voluntary motion, both chemical and mechanical stimuli, so applied, still increased the action of the heart; and *the irritating agents more than the mechanical*" (§ 224, 500 *m*, *nn*, 637, 694¾, 829, 893½).

487, *d*. It was also found by comparative experiments on the actions of animal and organic life, "that irritating or depressing agents, such as alcohol, alkalies, opium, tobacco, &c., applied to the brain, and spinal cord, exert a greater power over the heart than mechanical stimuli (such as variously injuring the structure of the brain), while the mechanical stimuli exert a greater power over the muscles of voluntary motion than the agents possessing peculiar intrinsic virtues" (*References* above).

487, *e*. Again, it was found "that stimulating every part of the brain and spinal cord equally affects the action of the heart (also, the stomach and lungs), while the muscles of voluntary motion are only excited by stimuli applied to the parts of those organs from which their nerves originate; that stimuli applied to the brain and spinal cord never excite irregular action of the heart, while nothing can be more irregular than the action they excite in the muscles of voluntary motion; that their effect on those muscles is felt chiefly on their *first* application, *but continues on the heart* (and blood-vessels) *as long as the stimulus is applied*" (§ 233½, 506, 516, no. 6).

487, *f*. In connection with this comparative inquiry, Philip has a remark which is worthy of deep consideration. "It is true," he says, "that although the heart is only influenced by agents applied to a large portion of the brain, we may conceive them so applied as to produce irregular action in it; and we find that certain irritations of the nervous system have this effect. But it is evident that the heart, not being subject to stimuli whose action is confined to a small por-

tion of this organ, and being equally affected through all parts of it, must render it much less subject to irregular action; which may be one of the final causes of the heart (whose regular action is of such importance in the animal economy) being made subject to the whole, and not to one part of the brain, and readily accounts for our not being able to produce irregular action in it by experiments upon the brain and spinal marrow." "When, indeed, the source of the nerves of the heart is considered, it will be found to derive its nervous influence from every part of the nervous system, and not very remarkably from any one part; a circumstance which particularly corresponds with the results of the foregoing experiments,"—and with the phenomena of sympathy as manifested in disease (§ 500 *m*, 1032 *d*).

Analogous observations are also applicable to all the other organic viscera; which farther proves that a great final cause of the ganglionic system is to unite the organs of organic life in one concerted action, while, also, it subserves their functions (§ 488½, 461½ *a*, 1041).

487, *g*. By the same facts we may explain why the heart and other organic viscera are affected through the brain, and spinal cord, after their power is so far weakened as no longer to convey the influence of a stimulus to the muscles of voluntary motion. As these muscles obey stimuli applied to only a part of the brain, or spinal cord, where the nerve supplying a muscle originates, if the impression on this part be not sufficiently strong to produce a muscular movement it cannot be assisted by any other part of the brain or spinal cord. Thus, it was found by Dr. Philip, "that a blow which affects the brain generally, without materially injuring it, produces comparatively little effect on the muscles of voluntary motion, because no one part of the brain suffers greatly; but it produces a great effect on the heart, because this organ feels the *sum of all the impressions*. (And so of the stomach, liver, intestines, &c.) The nervous system, therefore, may be so far exhausted (or affected) as not to admit of the vivid impressions necessary to excite the muscles of voluntary motion, and yet capable of those which influence the heart," blood-vessels, &c. This is strikingly seen in apoplectic affections.—NOTE B p. 1113.

The philosophy of this subject is farther explained in the following luminous manner by Dr. Philip: "Here," he says, "the question arises, by what means is the one set of organs (that is, the heart, stomach, &c.) subjected to the influence of *every part* of the brain and spinal marrow, while others are influenced by only small parts of those nervous centres? In these latter instances, we see directly proceeding from those small parts the nerves of the parts influenced. In the former instances, we do not see, in any case, nerves going directly from all parts of these organs to the parts influenced; but we always see this part receiving nerves from a chain of ganglions, to which nerves from all parts of the brain and spinal marrow are sent. It is therefore evident, from direct experiment, that the nerves issuing from the ganglions convey to the parts, to which they send nerves the influence of all the nerves which terminate in these bodies."

By the same philosophy, so clearly founded in nature, we readily interpret the vast extent of influences which may be propagated from the stomach, or other parts in organic life, by morbific and remedial agents, through impressions transmitted to the brain and spinal cord by way of the ganglionic system; while, also, all parts of the nervous

centres may be influenced in their organic condition by impressions upon any distant part (§ 230). This application, too, of the foregoing philosophy is divested of prejudice, since it was not contemplated by the experimenter (§ 1038).

487, *gg*. "The following case, related by the distinguished Dr. Parry, on the arterial pulse, might alone be regarded as proving the existence of two sets of nerves in the extremities; the one supplying the muscles of voluntary motion, the other the powers supporting the circulation, and strikingly illustrates what has been said on this subject. 'I have seen,' says Parry, 'a *total loss of pulse* in one arm with coldness, but *complete power of motion* in that part; while the other arm was warm, and possessed a perfectly good pulse, but had lost all power of voluntary motion'" (§ 113, 224, 399, 500 *nn*, 893½).

487, *h*. We may now readily perceive, from the vast difference in the results between the influence of the nervous power upon animal and organic life, how the muscular power, or *strength*, as it is usually called, may be excessively prostrated at the invasion of disease, while organic actions may be as greatly increased, or if depressed, they may be so modified as to require the application of remedies from which we might shrink if we regarded alone the prostration of the voluntary muscles. It is an ignorance of the principle which operates in these cases (as in the vast range of congestive fevers), and reasoning from the prostration of muscular power to a supposed analogous state of the great powers of life, and thus mistaking mere prostration of animal life for absolute "*debility*" of the organic viscera, that has led so extensively to the administration of stimulants and tonics, where bloodletting and analogous agents are most imperatively required. The mind, too, is inoperative in all these conditions, and the voluntary muscles languid, in consequence; and the very failure of the will to rouse them into action, where drowsiness has contributed its effect, has been often regarded as an evidence of that "*debility*" which calls for the "stimulant plan of treatment" (§ 473, 961, 893½).

It cannot, therefore, be too strongly enforced, that in all cases of sudden prostration at the invasion of fever the nervous power has a principal agency in the phenomenon,—that its influences on animal and organic life are widely different,—that it simply fails to stimulate the voluntary muscles, and hence the greater amount of apparent "*debility;*" while in relation to the organic processes, it has been so modified as not only to exalt, or perhaps depress, the forces of life, but to alter profoundly their very nature (§ 476 *c*, 500 *h*, *nn*, 893½).

There is nothing in the whole range of medical philosophy so practically important as these considerations (§ 569, 961, 967). It is a subject, however, which requires thought for its proper understanding, as well as a comprehensive view of profound laws in physiology. It is therefore repulsive to the many, who will rather rest upon the simple chemical and physical hypotheses than contemplate Nature in her dignified and rational aspects. The charm of simplicity which hung around the celebrated theory of John Brown encircles, also, the humoral and other chemical hypotheses, and adds its fatal delusion to those prevailing doctrines (1068 *a*).—Notes Ee p. 1133, Ff p. 1135.

488. An important remark is made by Philip at the close of his experiments relative to the functions of the heart, blood-vessels, and voluntary muscles, and their essential independence of the nervous

system, which goes to corroborate the conclusions I have drawn as to the agency of the nervous power in the healthy and morbid processes, of its modifications according to the nature of the agents by which it is developed, &c.; and this the more so, as Dr. Philip had formed no such inferences, but regarded the nervous power as the galvanic fluid, stimulating the various parts of the system, and a mere chemical agent in the formation of the secretions. I refer particularly to the clause in italics.

"It not only appears," says Dr. Philip, "from the experiments which I have laid before the reader, that the power of the heart and vessels of circulation is independent of the nervous system, but that that of the muscles of voluntary motion is so likewise, and that these, *like the former, are only subjected to this system* IN THE SAME WAY *in which they are subjected to every other agent that is capable of exciting them.* Thus we find, that all the *moving powers* of the animal body, as far as we have hitherto traced them, are independent of the nervous system, but that this system is equally capable of *acting as a stimulus to them, although in different ways*, whether they are subject to the influence of the will or not" (§ 133–162, 188½–190, 222–233, 205, 206, 208, 209, 256, 476 *c*, 484, 500 *h*, *m*, 826 *cc*, 893½).

488½. I shall now advert, once more, to the remarkable distinction between the operations of the nervous power as manifested in animal and organic life (§ 96–110). In animal life, the nervous power constantly influences, in a sensible manner, all the involuntary actions, and is obedient to the will in respect to all the voluntary muscles (§ 245, 476 *c*, 500 *h*). Its intensity of action, and consequent manifestations, depend upon the force or intensity of the exciting causes. For these habitual functions of the nervous power the cerebro-spinal system is specifically provided. Coming to the organs of organic life, we find them supplied with a system of nerves remarkably different from the cerebro-spinal, and a corresponding difference in the laws of nervous influence. This system serves as a medium through which the cerebro-spinal operates in organic life, possesses in its ganglia centres of reflex action which combine tributary influences from different parts of the cerebro-spinal, unites the organic viscera, supplies the stimulus to organic muscular tissue, and contributes a vitalizing effect upon organic compounds through a modifying influence upon the organic functions (§ 224, 226, 409 *k*, 456 *a*, 461½ *a*, 473 *c*, 475½, 500 *m*, 893 *a*, *c*.)

But there is this coincidence in the actions of the two lives; namely, the power which generates motion, both in animal and organic life, is independent of the nervous system (§ 205–215); but the nervous power is equally capable of influencing its operation, though in different modes (§ 226–233, 454–461½, 500, 893½).

489. The question is investigated by Philip, "*whether the power of secretion is also independent of, though influenced by, the nervous system.*"

Though settled by experiment, the analogies supplied by the vegetable kingdom are amply conclusive that the nervous system is only an excitant to the function of secretion, and dispenses a modifying influence upon organic compounds (§ 224, 409 *k*, 456 *a*, 461½ *a*, 488½, 893½).

From Philip's, and the experiments of others, it results, for example, that a division of the pneumogastric nerves either destroys or greatly impairs the digestion of food. But, says Philip, "it deserves notice, that the food, in such cases, is found covered with apparently

the same semi-fluid which we find covering the food in a healthy stomach;" and "the lungs are found *distended* with a frothy fluid, which fills the bronchi and air-cells" (§ 461).

It follows, therefore, that the function of secretion, and its *products*, are so far independent of the nervous system as to be only influenced through that system. Such is the inevitable conclusion from the experiments themselves; and yet their author was led into an important error by his hypothesis of the identity of the nervous power and galvanism (§ 409 *hh*, *k*, 493 *cc*, 893½, 902, 905 *a*, 1040).

5th. *On the Principle on which the Action of the Alimentary Canal depends.*

490. Philip destroyed separately, and simultaneously, the brain and spinal cord, and, in other instances removed both at the same time. In all the cases "the motion of the stomach and intestines continued till the parts became cold, so that when the intestines exposed to the air have lost their power, that of those beneath still remains." "It appears from these experiments that the power of the stomach and intestines, like that of the heart and blood-vessels, resides in themselves, and is wholly independent of any influence derived from the nervous system." This is true as to the *moving power;* but the experiment is defective in neglecting the sympathetic nerve, by whose reflex action the peristaltic movements were maintained (§ 889 *g*). In § 476½ *c* the air and mechanical irritation were equivalent to the stimulus of the nervous power (§ 473 *c*, 478 *b*, 483 *c*, 462–464, 498 *e*).

6th. *On the Relation which the Alimentary Canal and Lungs bear to the Nervous System.*

491. Direct experiments, as in the foregoing cases, by agents applied to the brain and spinal cord, show that the stomach, intestines, and lungs may be influenced through the nervous centres. "It often appeared," says Philip, "that spirit of wine applied to the brain and spinal marrow increased the motion of the canal;" that "the stomach, like the heart, is capable of being influenced by every part of the brain and spinal marrow" (§ 487 *g*). For these important investigations the reader is referred to the work itself.

Review of the Inferences from the preceding Experiments.

492. The following inferences are made by Dr. Philip in relation to his various experiments, and it will be seen that they are generally correct, and may be applied to the most important problems in physiology and practical medicine:

1. "That the vessels of circulation possess a power capable of supporting a certain motion of the blood independently of the heart.
2. "That the power both of the heart and vessels of circulation is independent of the brain and spinal marrow.
3. "That the nervous influence is capable of acting as a stimulus both to the heart and vessels of circulation.
4. "That the nervous influence is capable of acting as a sedative both to the heart and vessels of circulation, even to such a degree as to destroy their power.
5. "That the effect of the sedative is not the result of an excess of stimulus, but, like excitement, the direct operation of the agent.
6. "That the power of the muscles of voluntary motion is independ-

ent of the nervous system, and that their relation to this system is of the same nature with that of the heart and vessels of circulation, the nervous power influencing them in no other way than as other stimuli and sedatives do.

7. "That the cause of the muscles of voluntary and involuntary motion appearing, at first view, to differ essentially in their nature, is their being excited by stimuli essentially different; the former being always excited by the nervous influence, the latter, though occasionally excited by this influence, in all their usual functions obeying other stimuli. [This must be qualified as in § 456 *a*, 461½ *a*, 488½, 893½.]

8. "That the brain and spinal marrow act, each of them, directly on the heart, as well as on the muscles of voluntary motion.

9. "That the laws which regulate the effects of stimuli applied to the brain and spinal marrow, or the heart and muscles of voluntary motion, are different.

[This affirmation can be made only of certain differences in the modes in which vital agents affect the heart and voluntary muscles. A common principle is at the foundation of the whole (§ 500, *h*, 893½).]

10. "That mechanical stimuli applied to the brain and spinal marrow are better fitted to excite the muscles of voluntary motion, and chemical stimuli the heart.

11. "That the heart obeys a much less powerful stimulus applied to the brain and spinal marrow than the muscles of voluntary motion do.

12. "That stimuli applied to the brain and spinal marrow excite irregular action in the muscles of voluntary motion.

13. "That no stimulus applied to the brain and spinal marrow excites irregular action in the heart or vessels of circulation, nor is their action rendered irregular by sedatives, unless a blow, which crushes a considerable part of the brain or spinal marrow, be regarded as a sedative.

14. "That the excitement of the muscles of voluntary motion takes place chiefly at the moment at which the stimulus is applied to the brain and spinal marrow, while that of the heart may generally be perceived as long as the stimulus is applied.

15. "That after all stimuli applied to the brain and spinal marrow fail to excite the muscles of voluntary motion, both mechanical and chemical stimuli, so applied, still excite the heart.

16. "That the vessels of secretion, like the vessels of circulation, are independent of, but influenced by, the nervous system.

17. "That the peristaltic motion of the stomach and intestines is independent of the nervous system, [excepting its *stimulus* § 478 *b*].

18. "That their motion is capable of being influenced through the nervous system.

19. "That the stomach and lungs, like the sanguiferous system, are influenced by every part of the brain and spinal marrow.

20. "That the proof of the vessels possessing a principle of motion independent of their elasticity, which bears the same relation to the nervous system as the excitability of the heart, not only as far as respects the kind of influence which they derive from that system, and the way in which it is supplied to them, but also as far as respects the purposes for which it seems to be bestowed on them, affords a strong argument for believing that this power is of the same nature with that of the heart."

493, *a*. It is remarkable that the sagacious mind of Dr. Philip should have fallen into the error of deducing from his experiments the identity of galvanism and the nervous power, and the dependence of the secreted substances upon that principle. "The vessels of secretion," he says, "*only convey the fluids to be operated upon by the nervous influence.*" Here the "influence" is regarded strictly as a chemical agent. But, at the same time, he unavoidably concludes that "the *vessels* of secretion, like the vessels of circulation, are independent of, but influenced by, the nervous system;" galvanism, however, being the supposed agent in all the cases.* And yet Dr. Philip, through the light of galvanism, is led to the contradictory statement, "that, although the powers of circulation are independent of the nervous system, those of secretion are very far from being so." And, as to the products themselves, had he, or had others subsequently, considered the simplicity of the laws of Nature, and the remarkable Unity of Design which prevails in the fundamental constitution of all organic beings, from the humblest plant up to man, it never could have been entertained that the powers which circulate the blood, like those of the sap in the vegetable kingdom, and govern the action of the secreting vessels, are not derived from the nervous system, and yet that the formation of the secreted products is the work of the nerves. There is nowhere in Nature so great a violation of consistency; while, also, secretion is just as much a function of vegetables as of animals (§ 638). I am not, however, unmindful of the indisposition to predicate of final causes, or of any obvious Design, the intentions to be fulfilled, or any principle in philosophy which may be involved in the Plans of the Creator (§ 350¾, *kk*). But, since every thing in nature emanates from its fundamental constitution, I can have little doubt that we shall be gradually led to recognize the connection of philosophy with the Works of its Author, and to acknowledge that in all philosophy we are employed in seeking out the Institutions which He spoke into existence, and in doing which we may derive much assistance from going beyond the immediate phenomena, and thus, also, render philosophy and natural Religion, and of course, therefore, Revelation, subservient to each other.

493, *b*. Dr. Philip also adopted the error, which had been long propagated, of regarding the brain as a mere galvanic battery, and of course designed for the generation of galvanic fluid, and thus gave a farther impulse to those chemical hypotheses of life which have so extensively usurped the place of medical philosophy, was compelled to embrace these hypotheses himself, and thus to advance the very errors which have contributed to obscure the light which his experiments reflect upon every department of medicine (§ 350, nos. 5, 18–20, 42). It was his misfortune to have come upon the stage just at the overthrow of that philosophy which had been so highly advanced by Hunter, Bichat, Cullen, and their compeers, and the revival of the exploded physical and chemical doctrines of life, and of the humoral pathology. But his experiments must endure forever.

493, *c*. Again, having assumed that "the brain and spinal marrow are necessary to the function of secretion," Philip raises an objection which he foresaw would prevail. This objection consists in the ma-

* See *Medical and Physiological Commentaries*, vol. i., p. 52–68, 107–119, where the subject of galvanism is fully examined.

turity of the fœtus without brain and spinal cord; and to defend the chemical hypothesis, and the assumed identity of the nervous power and galvanism, and neglecting the sympathetic nerve, he assumes, that, when the brain and spinal marrow are absent, the *uterus* performs the functions of those parts to the fœtus; that is, it acts exactly as the brain and spinal cord in supplying the nervous power.* But this conjecture, independently of the absence of every fact, is contradicted by the total want of the requisite analogy between these two systems of organs. To give greater plausibility to the hypothesis, Philip remarks, that "no writer has before attempted to explain the difficulty."

493, *cc.* I shall have introduced many facts to disprove the dependence of animal products upon galvanism or catalysis. The agency of the former, as we have seen, is positively contradicted by the fact that plants, which are destitute of nerves, generate compounds very similar to animal (§ 409 *hh*); and farther on is an argument drawn from the electrical circle (§ 893 *a*). Again, cerebro-spinal nerves simply excite the voluntary muscles, while the sympathetic not only excites the organic muscular tissue, but exerts a peculiar vitalizing influence upon the organic products (§ 893½). Now, I submit that no reason can be assigned why galvanism should, according to Chemistry, act as a decompounding agent upon the blood when exercised through the sympathetic nerve, but not through cerebro-spinal nerves—especially as Chemistry alleges that it is an oxydizing agent of all muscular fibre. It need scarcely be added that whatever nervous influence is exerted upon the blood, it is, in all parts, through the sympathetic nerve (§ 111–117, 224, 226, 356 *a*, 409 *hh*, *k*, 456 *a*, 461, 475½, 488½, 893½).

493, *d.* Moreover, the eminent man who has contributed so largely to the philosophy of life falls into another common error now taught by the schools. Thus: "It is not to be overlooked," he says, "that the vessels convey the fluids to be operated upon by the extreme parts of the nervous system in a peculiar way. By the diminished capacities of the capillary vessels *the blood is divided as by a fine strainer*, some of its parts being *too gross* to enter the smaller vessels." "This," he adds, "is necessary to prepare the blood for the due action of the nervous influence" (§ 188, &c., 399, 408–411, 748).

Now, what can be more inadmissible than the comparison of the living, organized vessels, whose *actions* are *proved* by Dr. Philip to be influenced by the nervous power, to a set of dead, inorganic tubes?

In consequence of the foregoing mechanical hypothesis, Dr. Philip is compelled to give in his adhesion to the present physical doctrines of inflammation, as set forth in the sequel (§ 748, &c.). This, too, may be regarded as a principal reason why his experiments have not been applied to the philosophy of disease and therapeutics (§ 476 *a*).

Philip thus lost the opportunity of applying his observations to any useful or practical purpose. Nevertheless, his very misapprehension of their true import, and his diversion from the path of Nature, impart to them that inestimable value which belongs to the conviction that the facts lead only to the truth where they were intended for the support of error (§ 5¼, 188½ *d*).—See RIGHTS OF AUTHORS, p. 912.

494, *a.* In concluding this important subject, I shall bring up the late experiments by Van Deen, Stilling, Budge, and others, by which those of Philip have been again confirmed, and the results extended.

* This may be placed in the same category as some other "vicarious functions" of distinguished physiologists, as in § 83 *b*, 1086.

It will be seen that they have a very specific bearing upon the doctrines of humoralism (§ 819, &c.), and upon the modus operandi of morbific and remedial agents (§ 893, &c.). It might have been useful to have stated them in immediate connection with either of those subjects; but they should form a part of the combined force which marches in advance upon the regular plan of organization.

494, *b. Exp.*—After Fontana had made more than 6000 experiments, in which he employed more than 3000 vipers, and caused to be bitten more than 4000 animals, to extort the conclusion that the poison of the viper kills all animals by acting upon the blood, the whole of those 6000 experiments were overturned by a single one by Girtanner; showing that the poison will kill frogs entirely deprived of blood in as short a time as it kills those which have not lost their blood.

The conclusive nature of Girtanner's experiment has been entirely disregarded by subsequent humoralists, whether as it respects the operation of morbific, or of remedial agents; or more probably the experiment is unknown to most, or forgotten.—Note Aaa p. 1146.

The late experiments by Van Deen and Stilling are of the same import as Girtanner's, and again call upon physiologists to return upon the path of nature. Of these experiments I shall present one or two only, as being sufficient for every intelligible purpose connected with my subject.—Note B p. 1113.

It should be premised, that when all the viscera, the heart, blood-vessels, &c., are removed from frogs, so that nothing remains but bones, muscle, and nerves (as was done in Girtanner's experiment), the animal will hop about for half an hour, and appear in all respects as natural as in its perfect state. (See, also, Spallanzani, § 441, *f.*)

494, *c. Exp.*—The frogs being thus completely eviscerated, and all vascular connections with the spinal cord destroyed, Van Deen divided the cord through the third vertebra, and then introduced within the mouth a drop or two of the acetate of strychnia. In a few minutes, the parts above the section of the cord were affected with spasm, while those below were unaffected.

494, *d. Exp.*—Again, Stilling also eviscerated many frogs, after the foregoing manner, and, on applying acetic acid to the *skin*, as late as half an hour after the evisceration, he excited reflex movements.

494, *dd.* Observe, too, how an important modification of these experiments goes to the same conclusion. Stilling exposed the spinal cord of a frog thus completely eviscerated, and touched it with a solution of the acetate of strychnia, which gave rise to the same general tetanus as when strychnia was applied to the mouth or skin. Even an isolated portion of the cord would give rise to spasm in parts supplied by that portion, on being touched with the solution. From this fact, Stilling draws the conclusion, that if the cord be divided in numerous places, each portion is a nervous system in itself, and capable of transmitting influences through communicating motor nerves, independently of the brain, or of other parts of the cord (§ 459, 828).

In the foregoing experiments, which are only examples of a great variety by the same physiologists, we have another full confirmation of the preceding ones by Philip with the additional advantage of other agents to obtain the corresponding results. Nor will the reader fail to observe that the same remarkable phenomena occurred in the eviscerated frogs when acetic acid was applied to the *skin* as when the

acetate of strychnia was applied within the mouth, as in Van Deen's experiment (§ 494, *c*). This is an important element in interpreting the sympathetic influences of remedial and morbific agents when applied to the surface of the body (§ 1088 *b*).

It will be also seen that the foregoing experiments upon the skin coincide with those by Alston, made in 1733 (§ 484).*

These observations put at rest Müller's interpretation of the action of prussic acid in producing instantaneous death when a drop is applied to the tongue, and which has been extensively employed by the humoralists to preserve the purity of their doctrines. The more we consider the profound familiarity of the Berlin Philosopher with the laws of the physiological state of the nervous system, and his full recognition of the vital principle and all its attributes, the more are we surprised at his universal doctrine of physical absorption, and his extreme defense of the humoral pathology, as evinced in the following extract from his *Elements of Physiology*. Thus:

"The rapid effects of prussic acid can only be explained by its possessing great volatility and power of expansion, by which it is enabled to diffuse itself *through the blood* more rapidly *than that fluid circulates*, to permeate the animal tissues very quickly, and in a manner independent of its distribution by means of the blood," &c. And yet, in the same paragraph he states that nux vomica, which is not volatile, will produce the same speedy death (§ 500 *c*, 826 *c*, 827 *d*. Also, *Med. and Phys. Comm.*, vol. i., p. 565, 569, text and notes).

And again, says Müller, "My experiments, as well as many others, instituted by well-known physiologists, prove that, before narcotic poisons can exert their general effects on the nervous system, they *must enter the circulation*" (§ 657, 827 *d*–829, 904 *b*, 1032 *d*, 1066).

Müller's doctrine, I may also say, that the absorbent vessels have no visible orifices, and his physiological construction of their function, leads him to the propagation of errors which have vitiated the whole fabric of physiology and medicine. The doctrine may be summarily expressed in the following language of its author. Thus:

"The primary phenomenon of the immediate absorption of substances in solution into the blood is the *permeation of animal tissues* by the fluids. The property of permeation by fluids possessed by tissues, even after death, depends upon their *invisible* porosity, and is termed *imbibition*." Some of the consequences may be seen in sections 289, 291, 350, no. 24, 350½ *n*, 514½ *b*.—*See* § 1089.

494, *e*. What I have now stated of the experiments by Van Deen and Stilling relates particularly to influences exerted in animal life, though, like Philip, they have corresponding experiments in organic life. These it would be superfluous to repeat, especially as some of the foregoing involve a complex agency of the ganglionic nerve (§ 516, no. 13).

Budge, however, has lately made a multitude of experiments with a view to the physiological relations of the cerebro-spinal and sympathetic systems. There is novelty about them, and they go far in sustaining my philosophy of remote sympathy, and in all its wonderful details, and in corroborating that philosophy which I originally set forth in the "Commentaries" as to the *modus operandi* of morbific and remedial agents (RIGHTS OF AUTHORS, p. 915).—NOTE AAA p. 1146.

It will be observed, also, of Budge's experiments, that they are anal-

* WHYTT's experiment of killing frogs deprived of heart by giving them opium (1755) is also perfectly conclusive against absorption by the intestine.—WORKS, 4to, p. 300–302, 310, 320.

ogous to those which have been made by introducing different agents into the stomach capable of affecting the great nervous centres, and thus deducing the special influences of certain functions of the brain upon distant parts. The experiments in which the nervous centres were irritated should be, particularly, compared with those by Philip, in which he employed alcohol and tobacco. Thus:

Exp.—The heart of a frog having ceased to beat but once in fourteen seconds, the anterior cords of the cervical portion of the spinal marrow and of the medulla oblongata were irritated, when the heart beat once in three seconds. On first irritating the posterior cords, no effect ensued. In other experiments the action of the heart was restored, after it had ceased to beat, by irritating the anterior cords of the medulla oblongata with a needle, or by caustic potash. So, also, irritation of the corpus callosum reproduced the actions of the heart. Irritation of the cerebellum restored the movements of the stomach, and brought on vigorous contractions of the colon and urinary bladder. The last two organs were also affected in the same way by irritating the anterior part of the spinal cord (p. 303, § 481 *e*, Exp. 15).

The young student should be careful not to confound these move ments with those of continuous sympathy, as exhibited in § 498, &c. The foregoing are effected by a determination of the nervous power upon the organic properties of the several parts (§ 222, &c.).

IV. OF THE VARIETIES OR KINDS OF SYMPATHY.

495. We have hitherto seen that the several properties of life are distinguished by remarkable modifications, and that in some of the instances the varieties are so great as to amount to distinctions in kind (§ 133–163, 175, 177, 185, 190, 191, 197, 200, 215, 217, 219, 220, 226–230). And so, also, more or less, of the functions. The same rule obtains as to sympathy, this function having been divided by Mr. Hunter into *remote*, *contiguous*, and *continuous* (§ 452, &c.).

496. Remote sympathy is the principal condition of the function. Its office is the transmission of impressions, whether natural, morbific, or remedial, to and from parts separate from each other, or different parts of a compound organ, or through which the nervous influence is determined on parts which receive the primary impressions, or when that influence proceeds from direct impressions, physical or mental, upon the cerebro-spinal system itself (§ 230). In the last case, the rationale of the function is very analogous to that of voluntary motion (§ 233). In the former, it is reflex action of the nervous system.

497. Contiguous sympathy is a circumscribed condition of remote sympathy. Its peculiarity is shown by the effects of blisters, leeches, and various other external applications, in relieving internal disease, in proportion as they are applied most immediately over the internal part. Doubtless the centre of this kind of sympathy, or where the nervous power is excited and reflected, is the ganglia of the ganglionic system, or perhaps some plexus of nerves, or some parts of the sympathetic nerve itself (§ 473, no. 2, *c*; § 516 *d*, 893 *a*, 905). It should be observed, however, in these cases, that remote sympathy, in its clear acceptation, is brought into action (§ 1038).

The apparent effects of contiguous sympathy, however, may be sometimes explained, especially in consecutive morbid processes, by

the irritation from enlarged vessels, or from effusions of coagulable lymph, or dryness of surface, &c., as in pleurisy and ophthalmia.

498, *a*. Continuous sympathy is independent of the nerves, except as they enter into compound tissues. It is most strongly pronounced when unusual stimuli operate, and it always occurs in the tissue, or another continuous with it, upon which the primary impression is made. I would prefer calling it *continuous influence* (§ 1042).

498, *b*. Its mode of propagation consists in the condition of a particular part of a tissue, where some impression is made upon the organic properties, being extended to other parts continuous with it, in uninterrupted succession; though the changes may be much more intense in some parts of the tissue than in others (§ 516, no. 2).

498, *c*. In the natural condition of the being the operation of this principle is strikingly manifested in the various sensible motions of plants. For example,

"To excite the motion of the leaflets and petiole of the mimosa, it is not necessary that either the intumescence itself, or even the leaves, should be touched. The stimulus may be applied to a more or less distant part. Even the roots transmit the excitation to the leaves. M. Dutrochet moistened a small portion of the roots of the mimosa with sulphuric acid, and, *before there was time for the absorption of the acid* to have taken place, the leaves became folded" (§ 289).—MULLER'S *Physiology*.

And yet we learn from able physiologists that the whole connected movements of plants, in their circulation, and other organic actions, depend upon purely physical causes (§ 257, 261, 289–291, 293, 294, 303, 304, 1053–1055).

498, *d*. In the animal body, I have shown that the contractions and dilatations of the veins are greatly owing to continuous sympathy, the immediate exciting causes consisting in the existing state of the communicating arteries and the variable quantities of transmitted blood. Here, too, as in the circulation of the sap, the propagation of the continuous sympathy or continuous influence is exceedingly rapid, and results in a corresponding development of motion (§ 794, 795).

498, *e*. Again, as exemplifying the existence of continuous sympathy, and its independence of proper nervous action, take another fact from the animal kingdom, showing the action of other stimuli;

In the heart of many animals, "cut out and left undisturbed until the frequency of its beats shall have so far diminished that considerable intervals intervene between the contractions (or if it have entirely ceased to beat), mechanical irritation by means of a needle excites a contraction which cannot be confounded with the *regular* beats; and, at whatever part the irritation be applied, the reaction is the same as if the whole heart had been irritated; that is to say, there ensues a contraction not at one point only, but of the whole organ."—MULLER'S *Physiol*. A central ganglion would be necessary to nervous action.*

Bichat says of the foregoing experiment, if the action of the heart be allowed to cease entirely, and the organ be then pricked, it will not only begin to act again, but that a dilatation of the cavities will sometimes take place first. The action, too, may not begin till some seconds after the part is irritated (§ 264, 265, 475½, 516 *d*, 637, 647½).

498, *f*. Continuous sympathy is an important element in the physiology of disease and of therapeutics. This is conspicuously seen in

* See NOTES A p, 1111, BB p. 1131.

the propagation of inflammation from a central point. In a therapeutical sense, it is seen in the relief of hepatic congestions by leeches applied to the anus; when, besides the direct effect from loss of blood, the peculiar vital impression which is made upon the organic properties of the mucous tissue of the rectum by this mode of abstracting blood is propagated progressively along the whole tract of the membrane up to the duct of the liver, along which it is extended to the organ itself, whose secretion is thus, in part, increased, and the organ otherwise brought under a salutary influence. But, it is also true, that the impression which is made upon the intestinal mucous membrane is propagated to the brain and spinal cord by way of the sympathetic nerve, from whence the nervous power is reflected upon the liver, skin, &c., with a salutary effect, through the motor fibres of the same nerve; and thus remote sympathy is simultaneously brought into operation (§ 523, no. 6. Also, *Medical and Physiological Commentaries*, vol. i., p. 135, &c.).—RIGHTS OF AUTHORS, p. 912.

498, *g*. The continuous impression, in the foregoing case, upon the intestinal mucous membrane, is equivalent, in principle, to that which is produced by cathartics; so that reflex nervous influences may be propagated from all parts of the canal, as well as from the verge of the anus. Exactly the same order of influences springs from enemas and suppositories, whether of a sedative or purgative nature (§ 526). In all the cases, the functions of the liver are reached through the instrumentality of the intestinal mucous tissue, just as mechanical irritations of the conjunctiva, or of the membrane of the mouth, affect the lachrymal, or the salivary glands (§ 923, 524 *a*).*

498, *h*. Whether continuous sympathy will give rise to reflex nervous actions, and to what extent, will depend greatly upon the nature of the causes and the tissue affected (§ 135–152). It is strongly manifested in all irritations of the alimentary mucous tissue, but is seen but little or not at all in irritations of the muscular tissue, animal or organic.

499. The brain and spinal cord are, therefore, the sources of general reflex nervous action; but the ganglionic system not only participates in all the reflected actions upon the organic viscera when proceeding from the cerebro-spinal, but supplies in its ganglia, plexuses, &c., local centres of reflex action known as contiguous sympathy (§ 455, 456 *a*, 458, 459, 473 *c*, 478 *b*, 483 *c*, 490, 893 *a*, 905 *a*).

500, *a*. Remote sympathy may depend either upon impressions made upon the sensibility of parts distant from the nervous centres, or directly upon the centres themselves. In one case the function is associated with sympathetic sensation, in the other it is not (§ 451).

500, *b*. When made upon distant parts, the impression is transmitted to the nervous centres through nerves of sensation or the sensitive fibres of compound nerves, and brings the nervous power in those centres into unusual operation, from which this power is reflected through nerves of motion, or the motor fibres of compound nerves, upon the irritability of other parts, or of the part which sustained the primary impression, and thus gives rise to those various results which are the prominent phenomena of reflex nervous action (§ 455 *d*, 464–471), and which for brevity, I call *remote* sympathy, or *sympathy*.

500, *c*. The ordinary results of remote sympathy will follow impressions made directly upon the nervous centres, and, indeed, upon the trunks of nerves (§ 474, 507). These impressions may be made

* See NOTE U p. 1126.

upon the brain and spinal cord, and by all kinds of physical agents, and by the mind and its passions. The physical and the mental are alike operative. They rouse the nervous power, and modify it according to the nature of the cause, as in the former case (*b*); when it is transmitted to other parts, as in the more complex process (§ 222–233, 476–492). If the brain or spinal cord be irritated by the direct application of alcohol, it will increase the action of the heart and blood-vessels; or, on the contrary, their action will be diminished by the application of tobacco, opium, &c. (§ 476, &c.). And just so with the different passions, and emotions. Joy produces a lively action of the heart and all the cutaneous vessels; anger a more violent state of general arterial excitement; shame suffuses the face in one way, and love in another; fear subdues the action of the heart and capillaries, induces palpitation, covers the body with a cold sweat, and leads to unwonted micturition; jealousy is attended by other remarkable results in organic life; grief undermines digestion, &c. Disgusting sights, like emetics, produce vomiting, as will even their recollection. These cases are all coincident with those in which organic actions are influenced by irritating the brain or spinal cord mechanically, and involve exactly the same essential principle which is concerned in the most complex processes of reflex nervous action (§ 476, &c., 508). I call it *direct* action (§ 227).

500, *d*. The operation of the will, in producing voluntary motion, follows the same rule as that of the passions. Each is equally a cause of development of the nervous power. The will merely acts as a stimulus to the brain, by which the nervous power is developed and transmitted to the voluntary muscles, where, by its operation upon mobility, through irritability, voluntary motion is produced (§ 215, 226, 233, 243–246, 258, 467, 476 *c*, 818½, 1072 *b*).

"Irritability," says the able Macbride, "is to be held as a requisite foundation for the power of voluntary motion; for, if we may be allowed to make a comparison, the soul would be no more capable of moving any particular muscle, or set of muscles, if their fibres, in general, had not the property of irritability, than a musician would be capable of bringing music out of a violin, if its strings were not endowed with the property of elasticity" (§ 189, 206).

And this shows, us, also, the final cause of the exquisite endowment of all muscles in organic and animal life with irritability, while they possess only a low degree of sensibility (§ 193, 206).

We thus see, too, another remarkable exemplification of the manner in which the nervous power is so excited by the nature of the exciting cause that it shall give rise to voluntary motion. That the will acts as a stimulus, only, to the brain, and that voluntary motion is excited by the stimulus of the nervous power is manifest from the coincidence between voluntary motion and the spasmodic affections of the same muscles that arise from irritations of the gums or of the intestinal canal. The same is shown by the spasmodic actions induced by nux vomica, in paralytic affections; which also illustrates the distinction between irritability and sensibility, and shows that motion is effected by the organic properties (§ 184 *a*, 188, 193, 195, 206, 208). In this case, sensibility may be very obtuse in the affected limb, while the agent will exert a greater spasmodic effect on the paralyzed than on the sound muscles. This greater effect is owing to the morbid

development of irritability. And what farther illustrates the philosophy as to the action of the nervous power upon irritability in rousing paralyzed muscles, is the opposite effect of conia; for, in this case, conia paralyzes the muscles without impairing sensibility (§ 487, *gg*).

In all these cases of spasmodic action the irritations are propagated upon the cerebro-spinal axis, and prove an exciting cause of the nervous power; in the case of the will the irritation is direct in its analogous function of voluntary motion. But the coincidence is more perfect between the voluntary movements and the involuntary ones that are consequent upon irritations of the brain or spinal cord, as in Philip's Experiments, where the physical irritations are *direct*, and, therefore, upon common ground with the will and the passions (§ 477, &c.).

500, *dd*. The action of the will generally terminates in the muscles moved, but gives rise to reflex actions in roosting, &c., by placing the muscles in a rigid position, which acts as an exciting cause.* Mental emotions are but rarely reverberated in cases like transient blushing, but commonly give rise to reflex actions when they operate profoundly, as in vomiting, fear, grief, &c. (§ 500 *i*, *k*, 514 *f–m*, *Index II.*, Roosting).

500, *e*. Motion is produced in muscles that are partly voluntary and partly involuntary (as those of respiration) through the principles now stated; and the modus operandi of their involuntary movements also illustrates fully the philosophy of voluntary motion. Thus, in the involuntary act of respiration some peculiar impression upon the lungs, arising, perhaps, from want of air, is the cause of that development and transmission of the nervous power to the respiratory muscles which induces an action precisely similar to that which is excited in the same muscles by an act of the will. The only apparent difference is, that in the latter case the nervous power is excited by the will, and not, as in the other case, by an impression transmitted to the brain from the pulmonary mucous membrane. It appears to be a common phenomenon, also, for the will to determine the nervous power upon the muscular coat of the intestine, just as it is by the reflex nervous action of a cathartic. This is evinced by the quickened peristaltic action when on the way to the temple of Cloicina. It is an example, too, in which the will is seen to exert a retarding as well as accelerating effect upon the intestine. The will has a still greater control over the muscular coat of the bladder, by which that organ is excited into action in the voluntary discharge of urine (§ 518). In the foregoing cases, however, the will commonly operates upon the organic muscles through its associate action upon the muscles of the abdomen and perinæum (§ 243, 519).

Here, also, is presented another fact in proof of the exactness of Design, another display of the special modifications of the properties of life, since it is here, if any where in organic life, that the will may be instrumental in carrying out the final causes of nature, while there is no reason to suppose that the will can exert an influence on any other part of the truly organic system (§ 72–74, 136, 181½ *d*, 199).

500, *ee*. The principle concerned in the foregoing voluntary and involuntary movements is the same as when an emetic operates; only, in this instance, the peculiar impression transmitted from the mucous tissue of the stomach, through the sensitive fibres of the pneumogastric nerve, modifies and directs the nervous power in a way peculiar to itself; so that besides taking its reflected course through the respiratory nerves of motion, and exciting convulsive instead of respiratory

* See p. 891, § 1077, and Note A p. 1111.

movements, it falls upon various other parts, and may thus simultaneously induce copious perspiration, establish profuse secretions from the liver, intestines, &c., and break up croup, or pneumonia. Exactly the same law, also, is concerned when other remedial or morbific agents exert their effects upon parts remote from the direct seat of their operation. See RIGHTS OF AUTHORS, p. 912.

500, *f*. The foregoing analogy between voluntary and spasmodic motions, and the mixed motions of respiration, extends to those movements which are generated or influenced by the passions, and between the whole there is a close analogy with the effects of all physical agents, and all morbid states, which influence organic actions through reflex impressions of the ganglionic nervous system. The passions, also, like physical causes, produce involuntary movements in animal as well as organic life (§ 245, 844).

500, *g*. Different orders of nerves are, however, concerned in the transmission of impressions, more or less, according to the nature of the exciting causes. Thus, the nerves of volition are not those by which organic processes are influenced. Even in the voluntary muscles the irritability which is relative to their organic functions, as, also, sensibility, may be morbidly exalted, and yet the muscles be incapable of obeying the will, as often happens in paralysis (§ 487, *gg*). Again, other muscles, as those of respiration, are influenced both through the will and by reflex nervous action. And while, in these respects, we can recognize no anatomical distinction, either in structure or relation of the parts, this inscrutable phenomenon is not less paradoxical than the agency I have ascribed to the nervous power in the production and cure of disease; while yet more astonishing is the institution of different orders of nerves, even of fibres in common nerves, for the transmission of impressions to the nervous centres, and from those centres to the circumference; and more surprising still is the reception and transmission of impressions from these centres (§ 189, 234, 450 *e*). And still more remarkable is the manner in which the will, the passions, and other exciting causes of motion, through the agency of the nervous power, pass over intermediate nerves, and elect, as their motor channel, those which are variously disconnected in their anatomical relations (§ 233¾).* And here we may observe, farther, the analogy which subsists between the modus operandi of the will, and of physical agents, in developing motion (*d*). In all the cases, whether voluntary or involuntary, or mixed, as in respiration, the nervous power is roused and transmitted through motor nerves upon the irritability of all the parts that may be influenced (§ 188, 205). In the case of the will, and the passions, and of the immediate action of physical agents upon the nervous centres, the development of the nervous power is direct; but, when causes operate upon the nervous extremities, the nervous power is, of course, developed by impressions transmitted to the central parts (§ 113, 224, 475½, 891½ *g*, 893½, 1072).

500, *h*. Again, we learn from the foregoing considerations, that, since the will determines voluntary motion, but has no influence upon organic actions, with the exceptions stated (*e*); and since, on the contrary, the passions operate powerfully in organic, but imperfectly and only in an involuntary manner in animal life, and as judgment, perception, and reflection, exert no appreciable influences in either life, unless as morbific causes, or sometimes lessening the action of the

* See NOTE AA p. 1131.

heart, while each manifests special relations to the nervous system, it appears that all these causes or properties are distinct elements of the mental and instinctive principle; just as irritability, sensibility, mobility, &c., are distinct properties or elements of the vital principle (§ 175 *b*, 183, 188½ *d*, 234 *c*, 476 *c*), or *equivalent* (§ 1067, 1072 *b*).

500, *i*. Consider, again, how different agents applied to different parts will affect particular organs, remotely situated, in a very uniform manner, and, by common consent, through the nervous system; as the respiratory muscles, for example (§ 137). "The whole system of respiratory nerves can be excited to action by irritation of any part of the mucous membrane, from the mouth to the anus, from the nostrils to the lungs." This irritation may be established, and result in increased respiratory movements, by mechanical agents, as by tickling the fauces, and by many others through their intrinsic virtues, as tobacco applied to the nose. But, what is more remarkable, respiration may be also accelerated by impressions made upon particular parts of the surface of the body, as by tickling the feet; and again, by a strong light impinging on the retina; and yet, again, by hope and fear, by love and hatred. These examples embrace all the varieties that occur between the simple act of respiration and coughing, sneezing, and convulsive spasm. Again, another modified order of movements may be induced in the same muscles by agents of yet other virtues; as from the irritation of emetics. Mechanical irritations of the throat may also determine either coughing or vomiting; and here, as with the increased respiratory movements, certain irritations of the surface, as tobacco to the soles of the feet, will excite the abdominal muscles to the act of vomiting. In this last case, however, the irritation is first transmitted, by reflex action, to the mucous tissue of the stomach (§ 504), from whence it is returned to the nervous centres, and from thence reflected upon the respiratory muscles, the skin, &c. (§ 504, 514 *d*, *k*, *l*).

It will be thus seen, that these various agents, acting upon different parts, give rise to analogous or similar phenomena through the medium of the nervous power, but they involve a great variety of sensitive nerves, while the motor nerves are about the same in all the cases. This reflex nervous action is our *medical calculus*.

500, *j*. But, the foregoing complexity, which must find its solution in the attributes of the nervous power operating through its anatomical medium, is vastly increased by the coincident phenomena which may be determined by the will and by mental emotions. Thus, increased respiration, coughing, vomiting, &c., may be produced by an act of the will; grief occasions weeping and sighing; joy, laughter; yawning gives rise to yawning in another; disagreeable recollections produce vomiting, &c.

500, *k*. It is readily seen that a common philosophy must interpret all the foregoing effects. The fundamental cause is the same throughout. It is every where the influence of the nervous power; but what strange variety in the remote exciting causes! Nor is this all; for the same great and simple law obtains in all voluntary movements. Let us also especially remark the parallel which exists between the determination of the will upon particular muscles, according to its own choice, and thus constantly passing over, or isolating, various motor nerves, or, yet more remarkably, sending its influences through certain branches of a compound nerve and holding in passive subjection

all the rest, and of those agents which we have just seen to extend their influence specifically to the nerves of respiration, and those of a remedial or morbific nature which, like the will, elect and avoid the nerves without reference to order (§ 233¾, 492, no. 6). This astonishing phenomenon is perpetually in progress in health among all the organic viscera; and when we consider, also, how the well-trained juggler brings into simultaneous action almost every voluntary muscle, and each one in obedience to the foregoing law of elective influence, we shall readily comprehend how disease, and morbific and remedial agents, give to the nervous power the same complex direction in organic life. But even more remarkable are the various intonations of voice, and especially such as form the melody of song. Each one, every variation, whatever the succession of change, is determined by an act of volition, rousing, and determining the nervous power, with all the rapidity and mutations of thought, with varying intensity, and incalculable changes of direction, and compounded in an endless manner, upon those muscles which are the immediate instruments of the vocal apparatus (§ 234 *e*, 473 *c*, no. 6, 526 *d*).

All the effects of mental emotions are so many coincidences with the operation of remedial and morbific agents. Like the will, their effects may be limited to excito-motory nerves, but they are apt to institute reflex nervous actions; each emotion, too, acting upon particular parts according to its own particular nature (§ 500 *c*). Take, as an example for the whole, the coincidences between the effects of disgust and emetics. The latter irritate the gastro-mucous tissue and give rise to vomiting, as in § 500 *ee*. Equally, therefore, must disgust institute the same chain of causation; but by first determining the nervous influence as a nauseant upon the stomach (§,514 *b*, *c*, 1067 *aa*, 1072 *b*, 1077).

500, *l*. In what has been said, therefore, of the various exciting causes of motion in the respiratory muscles, alone, we have a great element by which we readily attain the philosophy of those analogous examples in which morbific and remedial agents establish changes in organs where the nervous communications with the direct seat of the morbific or remedial action may be obscure, or far less manifest than with other parts on which no sympathetic influence is simultaneously exerted. And, coming also to those complex influences which hold the iris in complete obedience to the great final cause for which it was ordained, and many other equally demonstrable but intricate problems relative to the nerves, and those others which concern an unintermitting action of the nervous power in maintaining some of the most exact and obvious conditions of animal life, as seen in the permanent contraction of the sphincter muscles, we have a flood of light upon the subject which will not fail to dissipate every remaining obscurity, and establish forever an impregnable barrier against the chemical and physical doctrines and all the corruptions of the humoral pathology (§ 1072 *a*).

500, *m*. If we now consider the actions of the heart and blood-vessels both in their natural state and under morbid influences, it will be seen that no chemical or humoral dogmas can have the most remote connection with the philosophy of medicine; for here will be found a concentration of phenomena which embraces not only the physiological conditions upon which all their fluctuations that emanate from the modified states of other parts depend, but a correspondence in the phenomena, that are wholly exclusive of every interpretation which can be

rendered by chemistry or humoralism within the entire range of pathology and therapeutics, and a full confirmation of my doctrines relative to the nervous system. In the first place, then, we have seen that the motions of the circulatory organs depend upon the nervous influence, as the immediate exciting cause, reflected upon the muscular tissue (§ 475½–488½, 493 *cc*, 514 *f*), and that in consequence of this susceptibility (§ 422 *b*, 487 *a*, 892¾), and of the liability of the nervous influence to endless modifications according to its exciting causes (§ 227, 230, 894 *b*, 904 *a*, 990½), that influence, both *reflex* and *direct* (§ 222 *a*, 227, 903, 990½), is constantly modifying the actions of the heart and arteries, as seen in the operation of multitudinous external natural causes and the multifarious effects of mental emotions, while other things, except when intermixed with the blood, fail of such influences (§ 233¾, 630 *c*), and of all which Chemistry and Humoralism do not pretend to make any explanation. Therefore, by parity of reason all the disturbances of the circulatory organs that proceed from affections of other parts, and all the remote effects of medicines, poisons, &c., are equally estranged from those assumptions, and in all the cases the fluctuations in the circulatory organs depend equally as in the natural conditions upon reflex or direct action of the nervous power, and as will appear (§ 687½–688, 694¾, 826 *cc*) we examine the pulse (when the heart is not diseased) for the purpose alone of ascertaining how far and in what manner the pathological conditions of other parts, or the operation of remedies, &c., may reflect the nervous influence upon the circulatory organs, and not in the least to ascertain how the blood is affected or the remedies may be absorbed—*See* § 829, 1088.*

500, *n*. Contrasted with the foregoing should now be stated the doctrine of the chemical school, as it comes applauded from the laboratory. The source of motion with this school, voluntary and involuntary, is the same with that which Liebig assigns for thought, namely, a chemical change in the substance of the organ (§ 350, nos. 5½, 7–10). In this way, too, the chemist expounds the balance between waste and nutrition; and for this purpose sleep has been ordained, the approved philosophy of which is the following:

"Now, since in different individuals," says Liebig, "according to the amount of force consumed in producing voluntary mechanical effects, unequal quantities of living tissue are wasted, there must occur in every individual, unless the phenomena of motion are to cease entirely, a condition in which all voluntary motions are completely checked; in which, therefore, these occasion no waste. This condition is called sleep. Now, since the consumption of force for the involuntary motion continues in sleep, it is plain that a waste of matter also continues in that state; and if the original equilibrium is to be restored, we must suppose that during sleep an amount of force is accumulated *in the form of living tissue exactly equal* to that which was consumed in voluntary and involuntary motion during the preceding waking period."—Liebig's *Animal Chemistry*.

I have quoted the foregoing on account of its appearance of a rational philosophy and logical method, but apprehend that it has no better foundation than the gaseous doctrine as presented in § 350½ *n*.

500, *nn*. But again, I ask the chemist for the primary cause of those chemical changes in which originate the acts of the mind, &c., and which call us from the sleeping to the waking state (175 *c*, 349 *e*,

* Also, § 481, 494, Note Ll p. 1140.

350¾ *gg*). I ask the chemist, and the physical philosopher of life, to explain the mechanism and the laws of sympathy by the application of any principle in physics or chemistry. Let the chemist consider, that in every process of remote sympathy there are involved very diverse, yet very precise effects, and that he must have one species of chemical change for the transmission of impressions through the sensitive nerves to the nervous centres, another for the impressions exerted upon those centres, another for the reflection of the influences through the motor nerves, and yet another for the effects exerted at the ultimate destination of this amazing round of never-ending influences, as indispensable to the process of respiration; and coming to morbid states, there must be another series of chemical changes conforming, respectively, to the nature of every morbid influence and product (§ 188½ *d*, 464, 451 *f*, 649 *b*, 675, 487 *gg*, 1076).

Take any single attribute of the nervous system, and we shall find it as remarkably distinguished from all things else as is the mental principle. The power which appertains to that system, and presides over the whole life of animals, is just as unique in all its operations. The distinction alone, in various aspects, between the condition of the sensitive nerves, or the sensitive fibres of compound nerves, and those which are appropriate to the motor influence,—those which convey impressions to the central parts and those which transmit them to all parts of the organization, to the organic structure of the fountain itself,—those, I say, which serve to awaken the mind, or to stamp on the nervous centres, with all the precision of thought, an inconceivable variety of influences which are unceasingly in progress in every other part, but with no other appreciable result than the movements which follow in all the organic constitution, contrasted with the totally distinct prerogative of those nerves, and those fibres of compound nerves, which give rise to the distant movements and changes,—place, at an unutterable distance, all analogy with the recognized imponderable substances and with every other agent or power in the mineral kingdom (§ 451 *c*, 453). But, I would not so far speculate upon the nature of the nervous power as even to assume for it a place among the imponderables, which the physical philosopher, upon no better evidence, unhesitatingly avows as the condition of light, heat, and that more inscrutable substance, imponderable magnetism, which awakens no sensation, and produces no effect upon organic life. Least of all would I place the principle of life, or its element the nervous power, upon a par with the imponderables in their designated condition as material "fluids," nor claim for the latter a distinct individuality (§ 175, *bb*). The true physiologist attempts not problems which have no relation to principles and laws, and which divert philosophy from its practical uses. It is true, he argues the existence of the principle of life, its remarkable attributes, its contradistinction from all other agents, upon the ground of the philosopher in physics, that he may meet the obtruder with his own ratiocination. He tells him that his premises are the same, only more various, distinct in their nature, and more demonstrative. He points him to his "undulations" of light, the velocity of their movements, the prismatic analysis, its confirmation by life, his imponderable mystery which spans the globe, its co-operation with the electric fluid, their instant transmission of a disturbing cause to the ends of the earth, making the record at one

of its poles ere the impulse has ceased which began at the other (§ 175 *bb*, 188½ *d*, 234 *c*, *d*, *e*, 281, 872 *a*, 892 *b*, 892½ *v*, 893 *q*, 904 *a*).

500, *o*. Let us now observe, summarily, the wonderful system of analogies which Nature has ordained among the vital stimuli, and learn from this, and from the same system of relationship which distinguishes other parts in the great chain of existences, that her laws are simple where the phenomena are various and complex, and that all her designs and operations are susceptible of reduction to a few general principles, which, when once known, illuminate the darkest labyrinth, and serve us instead of the voluminous facts which have been gradually accumulating for ages. One principle is a key to a thousand phenomena; and as new ones spring up, having analogies with such as are known, the principle comes to their ready interpretation.

In respect to the analogies among the vital stimuli, the mind, being connected with the body, and acting upon it both directly and through the nervous power, should naturally be one of them; and here we find it operating in peculiar ways upon the irritability both of organic and animal life,—first directly upon the brain, and then producing voluntary motion through the nervous power, or so affecting the organic states as to be a morbific or a curative agent. Just so with foreign agents. Irritate the brain and spasms will follow, while the same irritation goes to the recesses of organic life. The natural stimuli of life maintain the vital actions by exciting the vital properties. But, there are many foreign agents which are morbific, and these operate in the same way, only, at the same time, they alter the nature of the vital properties; and it is exactly in this way, also, that the mind and its passions produce disease. The impressions, however, in the former case, may be reflected from the nervous centres, while in the latter, they originate in those centres. Again, there are other foreign agents which aid in restoring the diseased properties and actions to a healthy state, and their principle of operation is exactly similar to that of the mind when this agent aids in the removal of disease (§ 1067).

Take next the blood, the natural vital stimulus of organic actions, which makes its impressions upon the same properties and develops the nervous influence like the mind and foreign agents. But, unlike the latter, it is a living agent, and calls into action the properties of life for the purpose of being itself acted upon, that it may be incorporated with the organized structure and receive the plenitude of those powers through which it becomes a part of the organized tissues, that this new formation may again generate the same fluid, and be acted upon, in its turn, by other blood. Its analogy, therefore, to the mental principle relates especially to its property as a vital agent. But, we find in the nervous power an agent of more extensive analogies with the blood, since this agent, like the blood, not only affects the organic properties and actions, but is also exquisitely susceptible of modifying influences, of changes in its nature, from the action of the mind and from external morbific and remedial agents,—acquiring even the very character, as an operating cause, which appertains to the agents, respectively, that may call it into action (§ 223–232). The range of analogies is, therefore, coextensive between the nervous power and all other vital agents (§ 74 *a*, 188½ *d*). And so of the semen in its action upon the organic properties of the ovum; infusing, also, not only a physical, but a mental constitution into the ovum. The

corporeal and mental attributes of both parents are, in consequence, blended together (§ 63, &c., 475½).

Consider, finally, the hibernating animal, whose general modification of irritability (§ 191) is so constituted with a reference to preservation against low degrees of external temperature, that mechanical irritation, heat, and a variety of agents applied to the surface, shall so awaken the nervous influence that his temperature will suddenly rise from below the 40th degree of Fahrenheit up to its natural standard of 98°. But the curious fact attending this remarkable law of preservation is the same result from an intensity of cold that would otherwise destroy the animal (§ 441, *d*).—Note Aa p. 1131.

500, *p*. In respect to the subserviency of the brain to the operations of the mind, I will add in farther explanation of what I have said in section 241, that, whatever may be the reality, the apparent instrumentality of the brain in the functions of the *will* and *perception* is greater than in those of *judgment*, *reflection*, and *imagination*; or, if it be preferred, the concurrent action of the mental faculties in man and animals determines the results which are commonly ascribed to the *will* as a property of the mind. The greatest apparent final cause of the brain in respect to the connection of the Soul with the body, and especially the Instinctive Principle, is to serve as a medium of communication with the voluntary muscles through the nervous influence.

In respect to perception, we discover the relation of the mind to the brain in another aspect, and, also, another analogy between the will and physical agents as vital stimuli. Through sensibility the brain is acted upon, and this impression rouses the mind, or its property, perception, and sensation is the resulting effect (§ 175, *c*).

501, *a*. Sympathy is *active* when it produces sensible effects. It is *passive* when its effects are insensible, as in the natural rhythm of the organic system. It is either *reflex* or *direct* nervous action (§ 638½).

501, *b*. In the perfectly natural condition of sympathy in organic life the nervous influence is a mere regulator of the organic properties. Its natural operation is disturbed by morbific and remedial agents, and by mental emotions.

501, *c*. It is mostly in conditions of disease that we notice the results of sympathy. In health we see only the universal harmony; unless disturbed by a blush, or by the abundance of urine when cold chills the surface, or fear exerts its more mysterious sway. Disease affords the striking examples of display in the nervous power, and these examples are what most engage the attention of the physician. To trace out their complexity, as one part after another gives rise to disease consecutively in each, and as each may exasperate the morbid states of the whole, or as remedial agents may institute corresponding circles of reflex action, are the most important and difficult objects of medicine.

502, *a*. Diseases generally begin with little agency of the nerves. Morbific causes make their impression upon the vital constitution of some particular part, when it commonly happens, sooner or later, that the affected state of the part is felt by the nervous centres, from whence a disturbing nervous influence is transmitted to other parts (§ 133–154, 188–193, 516, no. 7, 657, 666).

502, *b*. In all the foregoing cases, therefore, where remote parts become the seats of morbific action, as in pneumonia and idiopathic fever,

sympathetic sensibility is affected by the primary morbific cause as an important element in establishing the remote predisposition (§ 149, 201, 451 *b*, 559, 660, 666).

502, *c*. Remedial agents may operate directly upon a part and restore its morbid properties and functions without reflected nervous action. This is apparent only where the remedy is applied directly to the tissue affected; but, in all other cases the nervous power is the medium of transmission. Upon these fundamental principles, the main art of therapeutics is or should be founded (227, 644–647½).

503. When disease, or morbific, or remedial agents transmit their influence from any part to the brain and spinal cord, and there develop and modify the nervous power, the modification corresponds with the nature of the impression which is transmitted to the nervous centres. These transient modifications of the nervous power are similar, in principle, to the changes which occur in the organic properties, and which essentially constitute the disease. The passions also modify the nervous power in ways peculiar to each; and, in all the cases, corresponding effects are produced upon the condition of diseased parts upon which the nervous power thus modified may be reflected. That is to say, the nature of the nervous power is variously modified in all the cases; and, therefore, like external morbific or remedial agents of different virtues, modifies the vital states according to its own acquired modifications. The nervous power, therefore, thus acquires, more or less, the virtues of the exciting causes, and becomes, more or less, a substitute for them (§ 226).

504. Various circles of sympathy are generated by the action of remedial agents upon the stomach, intestines, &c. The first impression of the agent may set in motion a great range of reflex nervous actions; as the operation of emetics (§ 500, *i*); and, as new impressions are sympathetically instituted they become the points of departure for other reflex nervous actions, and react upon and increase those in which they originate. (§ 902, *g*, NOTE D p. 1114).

505. When the nervous power is excited by remedial agents of positive virtues it is essentially morbific, like the remedial agents themselves. Each is, therefore, curative only by inducing new morbid conditions by which the natural recuperative tendency of the vital properties is brought into operation. The great difference is, that morbific agents alter the vital conditions more profoundly and more permanently than the remedial (§ 854 *c*–858, 893 *d*, *e*, 894 *b*–901).

506. Impressions once made upon any part may continue for an indefinite time after the cause is withdrawn, and may continue to develop and modify the nervous influence, and direct its operation upon other parts, as when the agent was in operation (§ 516, no. 6). Thus, the operation of many active remedial or morbific agents will continue to be exerted upon the system at large, for a longer or shorter time, after they shall have been thoroughly removed from the stomach, &c. Inflammations excited by cantharides, issues, wounds, &c., hold an unceasing operation, curative or morbific, upon remote parts. The specific impression made by the virus of the mad dog becomes established in the bitten part, and generates a morbific reflex nervous action till, through the law of cumulation, an explosion of disease ultimately follows (§ 558, *a*). The same principle, exactly, is applicable to mercury, when a small dose, or its external application, produces saliva-

tion, or when miasmata give rise to fevers in a month, or six months, after their direct operation has been withdrawn. The principle is constantly illustrated in natural states of the body; as where the sphincters remain permanently contracted after the expulsion of the urine or fecal matter (§ 514, *g*, 516, no. 6, 1059, NOTE AAA p. 1146).

Here, then, we have another important law to interpret the true modus operandi of remedial and morbific agents (§ 503).

507. The nervous power pervades the whole system of motor nerves; and, although its active operation in the ordinary function of sympathy be developed mainly, if not altogether, in the central parts, it may be brought into operation by irritating any of the motor nerves (§ 473 *c*, 499). A division, or other injury of nerves going to the organic viscera, as the par vagum, may destroy their functions, or otherwise affect the vital constitution and products of the part, or induce inflammation, by the shock of nervous power thus inflicted on the organic properties of the part (§ 461, 485, 489, 950, 1032 *d*).

508. The nervous systems are as liable as other parts to be affected in their organic condition by the nervous power, which, in the same way, may be actively determined upon them. But, there is this difference. When any part of the nervous system is the seat of disease, it is liable to produce greater disturbances in remote parts than other organs when diseased. These disturbances are occasioned by the direct propagation of the nervous power, but they are apt to be less of a morbid nature than when produced by the more complex process of reflex action (§ 500, *a–c*).

509. The nervous power may extinguish life with great instantaneousness. When rapidly fatal, the causes by which it is brought into operation must be violent and sudden in their action (§ 455, *d*). Examples occur in the fatal effects of joy, anger, blows on the epigastric region, drinking cold water, prussic acid, sudden death from small losses of blood, apoplexy, &c. (§ 479, 1040).

In the case of joy, anger, and apoplexy, the nervous power is developed in a direct manner (§ 500, *c*), and destroys mainly by its sudden determination upon the organic properties of the brain and heart. Blows on the stomach give the same determination through reflex nervous action, as do also cold water and prussic acid (§ 476½, *h*). The mode of death from small losses of blood will be explained under the philosophy of the operation of its loss (§ 943, 946, &c.).

In the foregoing cases, the nervous power is also determined with violence upon the stomach and intestines, and upon the whole capillary system of blood-vessels (§ 481, &c., 490). The general effect is also increased by the injury sustained by the brain itself.

510. The foregoing modus operandi of the several agents is similar to the causation of sudden death from injuries of the brain or spinal cord. Thus:

If the spinal marrow be suddenly destroyed, or only one half of it, by a large stilette, life is immediately extinguished. The modus operandi appears to be the following:—1st. An injury of the vital properties of all the organic viscera. 2d. A violent interruption of the concert of organic actions. 3d. An interruption of respiratory movements. 4th. A pernicious nervous power is propagated from the cord to the organic powers of the brain. 5th. Pernicious influences are propagated by the organic viscera to the cerebral and ganglionic sys-

tems,—thus greatly increasing the destructive nervous influence upon themselves (§ 455, *c*). They are complex circles of nervous influence, but are determined by exact laws, and each circle has its distinct individuality, although involved in each other.

A like explanation is also applicable when a sudden destruction of life is effected by crushing the brain.

511. It is upon the principle that the effects of the nervous influence depend upon the exact nature of the impressions made upon the nervous centres, whether direct or indirect (§ 226, 500), that we must explain the differences in the results of slightly-varied experiments relative to these parts; those, for instance, by which the brain or spinal cord is slowly destroyed interrupting the harmony of actions and the organic functions more gradually, and therefore less fatally, than such as produce their destructive effects with greater rapidity (§ 476½).

V. THE LAWS OF SYMPATHY, OR REFLEX ACTION OF THE NERVOUS SYSTEM, AND THEIR APPLICATION TO PATHOLOGY AND THERAPEUTCIS.

General Facts and Laws relative to the Cerebro-spinal and Ganglionic Systems.

512, *a*. The various nervous communications of the intestinal canal with the brain and all other organs are demonstrative of the ascendant influence which the stomach, particularly, possesses when acted upon by remedial agents. We see all this exemplified, analogically at least, in the endless remote derangements which follow the common irritations and morbid states of the organ, as, also, of the intestines. We see, indeed, the whole in natural progress. When, for example, hunger operates, an actual sensation is then felt by the brain, and the mind, of course, participates (§ 323). Numerous and complex influences may be thus brought into operation, of which the stomach is the primary source. The will, being excited, brings into action all those muscles which are necessary to obtain a supply of food, and other muscles to effect its mastication, and convey it to the stomach. Various sympathetic organic influences are, in the mean time, taking place, which it is unnecessary, as it might be difficult, to explain. Many of these organic influences spring from the mind itself. Thus, the brain feeling the sensation of hunger, the salivary glands begin to pour out their fluid at the sight or smell of food, or even at its expectation. The food establishes an influence upon the nervous centres, by which an exciting nervous power is constantly reflected upon other parts. The bile, saliva, &c., are thus increased, while the mind contributes a direct nervous influence towards these results. The stomach being supplied with its wants, all these influences cease, and a new order arises. Cut off the par vagum and none of them will obtain, unless feebly through the ganglionic and spinal nerves. When the food has undergone digestion, and the exciting impression is removed from the stomach, all the reflected influences of the brain and spinal cord cease in consequence.

512, *b*. The vascular action and the glow of warmth, which are lighted up in the skin of the fasting, half-frozen traveler, and his invigorated strength before digestion has made any advances, and the flow of bile which is determined by the action of food on the stomach, especially where the food is of an animal nature, are manifestly

owing to an exciting reflex action of the nervous system; or, again, the copious perspiration, and other results, which often follow immediately a draught of hot water, illustrate the whole philosophy of this apparently entangled subject of sympathy, whether in relation to natural, morbific, or remedial agents; and we learn from these obvious examples that the essential principle is simple, and readily explains all the diversified phenomena, which are effects of reflex and direct nervous actions, whose original starting point is the gastro-intestinal mucous membrane. But when, in the case of the food, it shall have been digested, and have entered the circulation, some of its earliest and strongest demonstrations may have disappeared. It is worthy of remark, too, that such is often the immediate effect of food upon the great nervous centre, that sleep is almost irresistible, or apoplexy follows, "paulo post prandium,"* as no unusual result; the nervous power being reflected, in the former case, upon the organic properties mildly and agreeably, in the latter with sudden and destructive violence (§ 226–233, 441 *c*, 476½ *h*, 500–511, 1040).

513. Physiological conditions, like the foregoing, are so intelligible as to be peculiarly important in illustrating coincident problems in pathology and therapeutics. Whenever well-pronounced reflex nervous actions are propagated from one organ to others through the cerebro-spinal and ganglionic systems in their natural states, and by natural stimuli, as by food, these influences are generally greatly increased, as well as modified in kind, by morbific and by remedial agents (§ 524, no. 1).

514, *a*. The foregoing considerations lead me to the statement of one of the most important laws in physiology, which is alike applicable to the cerebro-spinal and ganglionic systems, namely:

"When impressions, made by the action of external stimuli on sensitive nerves, give rise to motions in other parts, these are never the result of the direct reaction of the sensitive and motor fibres of the nerves on each other. The irritation is conveyed by the sensitive fibres to the brain and spinal cord, and is by those communicated to the motor fibres" (§ 455, 462–472).—MÜLLER.

The foregoing law is in operation in all cases of remote sympathy, whether of a physiological, pathological, or therapeutical nature (§ 455, *c–h*). It is clearly exemplified in the natural process of respiration, by the analogous results of emetics, &c. In respiration, the want of air is felt through the medium of the sensitive fibres of the pneumogastric and sympathetic nerves, and appears to be concentrated about the medulla oblongata. The nervous power is thus developed, and is then reflected upon the various motor nerves which supply the muscles of respiration; when the action of these muscles follows as a consequence (§ 233, 462–472, 500).

514, *b*. The only remarkable difference in the physiology of vomiting from that of respiration consists in the primary impression being made upon the same nerves in the mucous tissue of the stomach, and the convulsive movement of the abdominal muscles. A radical difference, however, obtains in the influences which may be exerted by an emetic upon the organic states; especially in their diseased conditions. This, too, will depend greatly upon the cause of vomiting; and so of every other agent, according as it may be natural, morbific, or remedial. When the effects depend upon reflex nervous influences,

* A term of frequent occurrence among Authors who wrote in Latin.

the morbific and remedial agents so modify the nervous power that it alters the existing condition of the organic properties and functions of all parts upon which its positive action may fall (§ 129, 226, 227).

If the stomach itself be the seat of disease, even its mucous tissue, the remedial effect of any agent may not be wholly, or principally, due to its direct action upon the organ, but may be also exerted through a chain of causation exactly similar to that by which the respiratory muscles are thrown into action in respiration or vomiting. This must be obvious enough in the case of peritoneal disease of the stomach; and it is equally true of diseases of its mucous coat, that the impression of the remedy is transmitted, more or less, through the sensitive fibres of the pneumogastric and ganglionic nerves to the brain and spinal cord, when the nervous power is reflected, with an alterative effect, through the motor fibres of the same nerves upon the mucous, as upon the serous, tissue of the stomach. The same philosophy applies to the muscular coat of the stomach in the action of an emetic, and to the same tissue of the intestines when peristaltic movements are excited by cathartics (§ 657 *a*, 658, 889 *a*, 902 *g*).

Again, the bile which is ejected during the action of an emetic or a cathartic may have been mostly generated under their influences; the emetic or the cathartic establishing a *bilific* reflex nervous action over the liver, in conjunction also with continuous sympathy (§ 498); and those influences, in connection with the more efficient direct irritation of the intestinal mucous tissue, instituting the increased product of that membrane. These palpable facts associate themselves with the immediate exciting cause of the muscular movements in vomiting and defecation, and with an endless extent of analogous results that flow from other unusual influences, and thus evince the dependence of the whole upon the foregoing causations, of which alterative reflex nervous actions are apt to be the principal.

514, *c*. We thus comprehend how an emetic of the most simple nature may suddenly arrest a paroxysm of hooping-cough, or of spasmodic asthma, or of hysteria. The emetic, through the foregoing process, induces new movements in the affected muscles, and thus ends the paroxysm. Dr. Greenhow, for example, has lately related, in the London Medical Gazette, the case of a man, who was affected with a choking, as if a ball was rising in his throat, and shortly after a violent hiccough began, which continued for several days. About the eighth day, his wife, sister, and maid-servant, "got into the same state;" the affection being communicated in the last three cases or induced by the operation of the mind (§ 227, no. 1, 844 *a*). "It was a painful spectacle, though a somewhat ludicrous one, to see four individuals all hiccoughing at the same time." Opium, valerian, asafœtida, camphor, magnesia, &c., failed entirely of affording relief. "However, something taken by the maid-servant made her vomit, and from that moment the complaint ceased. A mustard emetic was immediately ordered for the others, when the sister and wife were also relieved; but not so the husband, whose attack, however, was always suspended by vomiting, but soon returned." In the case of the husband, there was present a state of disease, which continued to reproduce the paroxysms; but in the other three there was little else than the spasmodic action of the muscles. Dr. G. says he "always afterward found that vomiting put an end to attacks of hysteria, and believes that the *dread* of an emetic has often had the effect of checking

an hysterical attack;" in which case the mind develops a controlling nervous influence.—Note Cc p. 1132.

514, *d*. Consider, next, an example of the manifestation of sympathy between the skin and other parts, as indicative of the modus operandi of remedial and morbific agents when they establish their influences upon distant parts through the medium of the skin.

Volkmann, in pointing out the great difference between the trunks and the minute terminations of the nerves in the power of exciting reflex motions, prefers the skin for illustration; which, he says, surpasses all other organs in the property of exciting these motions. When an animal, for example, is under the influence of opium, the slightest touch of the skin is frequently sufficient to give rise to strong spasms, while reflex actions excited by irritating the distinct nerves of the skin are generally less. The philosophy is the same when cold air, or cold water, restores a patient from a state of syncope. A drop of cold water, when snapped upon the face, rouses the subject by transmitting an impression through the cutaneous nerves to the nervous centres, which instantly develops an exciting nervous influence that is then reflected upon the muscles of respiration, and upon the heart and extreme blood-vessels. The same law governs, also, the constant mutual interchange of action between the skin and alimentary canal, the skin and kidneys, &c., whether in health or disease. From these examples of a great fundamental law, we readily obtain the modus operandi of mercury, iodine, blisters, issues, &c., when applied to the skin, and of cold in reducing hernia (§ 224, 232, 527 *b*, 1088 *b*, *c*).

514, *e*. With the qualifications stated in sections 458, 459, it is "a general law, that, whenever general spasms are excited by local impressions, the phenomenon depends on no other communication between the sensitive and motor fibres than exists in the spinal cord. In many cases, however, local irritation of the nerves gives rise, not to general, but to local muscular spasms." "In the contraction of all the perineal muscles in expelling the semen, which are excited by irritation of the sensitive fibres of the penis, the spinal cord is the medium of communication between the sensorial impressions and the movements."—Müller.

514, *f*. Many "muscles invested by sensitive membranes, and are not themselves exposed to the direct stimulus, can only be excited to action by irritation of the sensitive property of their investing membrane, the transmission of this irritation to the nervous centres, and the propagation of the motor influence from the nervous centres to themselves. Thus, the contractions of the glottis and air-passages, excited by the contact of irritating gases, are not the immediate result of the irritation of the parts themselves, but of the excitement of the sensitive fibres distributed to the mucous membrane and the reflected influence of the brain and spinal cord upon the motor nerves of the muscles. The movements of deglutition belong to this class. The stimulus of the morsel in the fauces excites the act of deglutition. In this case, the sensitive nerves which transmit the impression to the nervous centres are, according to Dr. Reid, the glosso-pharyngeal, the superior laryngeal, and the branches of the fifth, sent to the soft palate and isthmus of the fauces. The motor nerves for the movements of deglutition are the pharyngeal branches of the par vagum. A like explanation applies, also, to the irritations of the sphincter ani and the

sphincters of the bladder. The muscles cannot be themselves stimulated by the excrement and the urine; but these matters act upon the sensitive nerves of the mucous membrane and excite the spinal cord, which, as if *constantly charged with motor influence*, *reacts upon the muscles*. In this case the phenomenon appears to depend on no other communication between the sensitive and motor fibres than exists in the spinal cord. Hence, after injury of the spinal marrow, these sphincters become relaxed."—MÜLLER.

The operation of cathartics involves more complex laws. These are agents of specific virtues, and are capable of modifying the vital states of the intestinal canal and of parts remotely situated. Their direct impression is exerted upon the intestinal mucous tissue; but the *muscular* is brought into increased action both by contiguous and remote sympathy (§ 497). This renders it manifest that reflex nervous action is concerned in the ordinary peristaltic movements that are induced by the natural contents of the alimentary canal (§ 475½, 490); nor, indeed, is it conceivable that either the intestinal muscular tissue or that of the heart can be reached in any other way than by the stimulus of the nervous influence excited as in § 475½, 490. But in the case of cathartics, something more happens. The influence being extended to the nervous centres, the nervous power is propagated through motor fibres of the pneumogastric and sympathetic nerves upon the intestinal mucous tissue, by which the various influences of these agents are increased, as in the experiments by Wilson Philip (§ 113, 224, 226, 475½, 491, 889 *a*, 1042, 1088 *d*).—NOTES A p. 1111, BB p. 1131.

514, *g*. The sphincters remain contracted after the expulsion of the fæces and urine. This is owing to the permanence of the impression upon the mucous tissue, which maintains an excitement of the nervous influence till the excrements are again deposited. And so of the continued influences of remedial and morbific agents long after the agents themselves have ceased to operate; the impressions remaining upon the parts where their direct action had been exerted. In this way miasmata, the virus of the mad dog, mercurial and other remedies which may be slow in the full development of their effects, establish their influences where their direct action may fall, and these are subsequently and slowly propagated to other parts by unceasing alterative reflex nervous actions (§ 516, nos. 2 and 6, 578 *d*, 657 *a*). See also *roosting* (§ 500 *dd*).

514, *h*, More complex examples of the law with which this section was begun will be presented hereafter. Such as have been stated are intended as introductory to the series of laws which are soon to follow. But we see from examples already produced, that when sympathies are set up in one part they may become the cause of sympathies in other parts, and that in this manner remedial and morbific agents, which begin their action on some given part, may establish very complex sympathetic effects, each modifying the others through new influences upon the nervous power (§ 228). When the food, for instance, as in § 512, induces vascular action and warmth in the skin before digestion commences, that organ excites salutary reflex nervous influences on the digestive organs, and thus promotes digestion. When tartarized antimony, in small doses, induces a sudorific nervous influence, the skin becomes the source of many reflex nervous actions upon other organs; thus showing, also, that it is not the perspiration, but the vital change in the organ itself, which leads to results that can-

not be imitated by any other mode of exciting this excretory function And so, more or less, of other parts upon which the antimony may exert its primary sympathetic effect (§ 863, *e*, 902 *g*).

Thus it happens, that whether certain remedial agents are applied to the stomach or skin, reflex nervous actions are propagated to each, as well as from each to other organs, while each, in its turn, reflects the impressions back to the brain and spinal cord, from whence they are again returned with increased intensity; or organs not before involved are ultimately brought under their influence (§ 129 *h*, 674 *d*). And so of disease of any given organ; which is only equivalent to the influences of morbific causes (§ 647, 660).

If two or more remedial agents be united, it is readily seen that their combined effect may be extended from the stomach to various parts of the body, and thus other alterative reflex actions propagated among themselves, and variously determined upon other parts (§ 872 *a*).

514, *i*. We may now regard an example which presents a union of the physiological, pathological, and therapeutical principles, as set forth by myself, in their relation to the nervous influence; all referable to one common law in its connection with modifications of the nervous power (§ 226). Thus: "Certain cases," according to Marshall Hall, "as hydrophobia, epilepsy, hysteria, and certain remedies, as strychnia, cantharides, &c., not only induce augmented excitability, but manifest their effects upon the organs which are physiologically under the dominion of the excito-motory power."

514, *k*. Finally, a glance at the physiology of the contraction of the iris may aid our understanding of the complex sympathetic influences of morbific and remedial agents, and of the applicability of the following physiological laws to the modus operandi of such agents.

It is first worthy of observation, that the iris may be pricked with a knife without exciting contraction, while it is exquisitely sensitive to the action of light (§ 74 *a*, 188½ *d*, 136, 137). The co-operation of a sensitive and motor nerve, through the medium of the brain, is necessary to this phenomenon. The impression upon the retina, being transmitted to the brain through the optic nerve, is reflected upon the iris through the motor ciliary nerve. This may, perhaps, open the eyes of the chemist as to the true doctrine of vision (§ 188½ *d*, 500 *nn*). But it is a more interesting fact, that when one eye is closed, and the other open, the pupil of the closed eye will follow, in a measure, the movements of the open eye; and this will happen to an amaurotic eye when the sound one is exposed to the stimulus of light. This sympathy between the two eyes, as well as in other respects, and the harmony between the two ears, involve very delicate considerations as to the influences of the nervous centres, and may be employed in tracing out the philosophy of many obscure interchanges of action among different organs, either in their natural states, or when they are disturbed by morbific or remedial agents (§ 1072, *a*, *note*).

514, *l*. A multitude of illustrations may be brought to the same purpose, which show us, also, how complex may be the influences of morbific and remedial agents, and how the mind may participate, when these agents operate upon the organic properties which conduct the insensible movements. Thus, sneezing is commonly produced by the action of stimuli upon a nerve of common sensibility distributed from the fifth pair to the mucous tissue of the nose, and the

reflection of this irritation upon the respiratory nerves. But the stimulus of the sun's light may produce sneezing by acting first upon the optic nerve, and through that medium upon the nervous centres. The nervous power thus developed is reflected upon the Schneiderian membrane through the motor branches of the fifth pair which imparts common sensibility to the nose (§ 198). Here a new sensation arises, which is sent back to the brain and spinal cord, the nervous power again developed, and, according to relations between that membrane and the respiratory organs, and the nature of the remote cause, the nervous power is reflected upon the respiratory muscles, when sneezing follows as the result of the convulsive movement. (See, in connection, § 188½ *d*, 500 *nn*.)

The mind itself will do the same thing by dwelling intensely on a former paroxysm of sneezing. Here the nervous power is excited in a direct manner by the mind, and is then, as in the foregoing case, directed upon the nasal branch of the fifth pair. And so of sympathetic yawning, sympathetic micturition, vomiting from disgust, &c.

514, *m*. The olfactory nerve is mostly endowed with specific sensibility, and is only excited by odors, while they have no such effect upon the nasal branches of the fifth pair, unless the odors be at the same time of a pungent nature; and then it is the *pungency*, not the *odor*, that operates. Odors affect the mind agreeably or disagreeably. The smell of a rose may have no other effect than that of so impressing the brain as to give rise to a pleasurable sensation. But, in some constitutions its impression will excite a variety of reflex nervous actions. Its effect may be at first pleasurable, but followed immediately by the transmission of a disturbing influence to the heart, or stomach, or even to the intestines. The heart may be thus depressed in its action, the stomach nauseated, and the bowels have been purged by the same cause. Hence the poet's expression, to "die of a rose in aromatic pain." Even the recollection of disagreeable results from offensive odors brings on nausea and vomiting (§ 500, *i*, *k*. See, in connection, § 188½, *d*).—Note D p. 1114.

Laws of Action of the Sympathetic Nerve, and the Propagation of Impressions in it.

514½, *a*. Having now, and in former sections (§ 471–475, 477–496, 500), stated the most important facts and laws which relate to the cerebro-spinal system, whether acting independently, or in connection with the sympathetic nerve, I shall proceed to speak of those which concern especially the latter system. But the cerebro-spinal is so interwoven with the sympathetic nerve, it is obvious that the influences which appertain to the brain and spinal cord must be more or less common to the ganglionic nerve (§ 115, 458–460, 893 *a*).

514½, *b*. The following laws are generally inferable from what has been already said of the nervous power, and of sympathy. But, I have deemed it most useful to the young student of medicine, and possibly to the more advanced, to present them in a brief and systematic form, with comments of a practical nature. The quotations are from Müller, unless otherwise stated. In this branch of physiology Müller is eminently philosophical; and in thus adhering to the path of nature, he is arrayed in opposition to those chemical and physical views with which he has thought proper to oblige the mate-

rialists of the age, and which prevail in other parts of his work on Physiology. After variously expounding the laws of the vital principle, and reasoning as a philosopher upon the abstract subject of reflex nervous influence, like Marshall Hall, and others, he cuts loose from all analogies, and from the whole philosophy of the vital properties. As in the equally remarkable case of Wilson Philip, he ascribes all the organic functions and products to physical and chemical agencies,—maintaining that,

"The formation of any one of the peculiar secretions, the essential proximate constituents of which do not exist in the blood, presupposes *the operation of a special chemical apparatus, whether this be a membrane or a gland.*" Of all morbid states, he affirms, that "*All these phenomena are owing to a noxious matter absorbed into the blood, or generated in it.*"

The same humoral interpretation is applied to the modus operandi of remedies, which, like morbific agents, are supposed to be taken into the circulation by endosmosis or by capillary attraction, and it is quite "*uncertain*," he says, "*whether the matters are first received into the blood-vessels or lymphatics.*"—MÜLLER'S *Elements of Physiology.* Also, *Medical and Physiological Commentaries*, vol. i., p. 37, *note*, 56, *note*, 565, 570, 684, 685; *and this work*, § 494, *dd.*

I have thus adverted again to the discrepances in the views of this philosopher, that the reader may appreciate the value of his luminous exposition of the laws of sympathy, since they contemplated no theoretical conclusions in pathology or therapeutics.

515. It is still a controverted question how far the sympathetic nerve is independent of the brain and spinal cord, though in their natural state the intimate physiological relations of the latter to the former admit of no doubt (§ 459). Microscopical investigations have been carried on extensively with reference to this inquiry by Valentin, Volkmann, Bidder, Müller, Remack, Henlè, Purkinje, Rosensthat, Pappenheim, and some others less known in the walks of physiology. As may be readily supposed from the nature of the investigation, and the means relied upon, there has been great discrepancy, and even entire opposition, in the principal statements and conclusions; all tending to strengthen my objections to the use of the microscope in anatomical and physiological inquiries (§ 131.* Also, *Med. and Phys. Comm.*, vol. i., p. 699–712; and *Examination of Reviews*, in vol. iii., p. 6, 89).

We know enough, however, of the relations of the sympathetic nerve and cerebro-spinal systems, and of their connections with other parts, and enough of the phenomena which grow out of those relations, to lay down the important laws of sympathy; and these are what we require for practical purposes.

Of the Actions of the Sympathetic Nerve in Involuntary Motions.

516, *a.* 1. "All the parts subject to the influence of the sympathetic nerve are incapable of voluntary motion," except as in § 500 *e.*

2. "The parts which are supplied with motor power by the sympathetic nerve still continue to move, though more feebly than before, when they are separated from their natural connections with the rest of the sympathetic system, *and wholly removed from the body.*"

This is an important fact, as contributing to prove that the viscera of organic life obey not only the nervous power, but other stimuli, and

* Observations have become more accurate and greatly multiplied, but the essential objections remain, as in most other physiological processes.—1860.

that all the essential processes are carried on by properties peculiar to themselves (§ 184, 188, 205–216, 222–232, 475½, 476–492, 494, 500), though constantly influenced by the nerves (§ 456 *a*, 746 *c*).

516, *b*. Clear demonstrations of the foregoing law abound in the history of organic life. That in relation to the extirpated heart, where the air and mechanical irritants were equivalent to the nervous stimulus, illustrates the subject (§ 264, 498 *e*, 637).

516, *c*. Again, if the intestines be removed from the body, and some part of them irritated, their motion is increased, "and this effect continues long after the stimulus is withdrawn, and does not *immediately* attain its greatest degree." And so with the heart. Its contractions may not begin till some seconds after it is irritated, and they may then be long continued (§ 516, nos. 6 and 7). This does not show, however, that the nerves do not supply the natural stimulus of the muscular tissue, but only that other stimuli will excite its action (§ 475½, 478 *b*, 490).

516, *d*. We have, therefore, in these examples, a type of all the movements which arise from continuous sympathy* (§ 498, 524, no. 2), and a proof of the existence of the organic properties, of their independence of the nervous system, and of the active, vital nature of the dilatation of the heart (§ 498 *e*). The principle is of great moment in a pathological and therapeutical aspect. We see, for example, that the direct facts, and the analogy supplied by the active dilatation and contraction of the heart, substantiate a rythmic, consentaneous movement of the arteries (§ 384). We carry this with the other facts to pathological conditions. Thus, when the extreme capillaries of the skin, as of the finger, for instance, or any other part, are irritated mechanically, or by any chemical or other agent, an inflammation may be excited at the point irritated; just as the heart, or intestine, is roused into action by the prick of a pin. The inflammation then extends, progressively, from the point irritated, the finger throbs, its principal artery begins to pulsate, and finally the radial. And so of the irritation of the ducts of glands, by which the glandular secretion is increased. Generally, also, remote sympathy, or reflex action of the nervous power, is simultaneously brought into effect.

3. "Hence, all the parts endowed with motion and supplied with nerves from the sympathetic, are, in a certain degree, independent of the brain and spinal cord." This can apply only to the structures of organic life, and as they may enter those of animal life—thus distinguishing the cerebro-spinal from the ganglionic system (§ 215, 233, 475½, 487, 893½).

4. "The central organs of the nervous system can, however, exert an active influence on the sympathetic nerves and their motor power" (§ 222–232, 475).

This is a very important physiological fact to the physician, and is fully established by the experiments of Philip, Valentin, Müller, and others, and is conspicuously shown by the effects of the passions.

It is through the liability of the whole body to be influenced by the nervous power of the brain and spinal cord through the sympathetic nerve, and as generated by the central parts of that nerve that I interpret the whole philosophy of sympathetic diseases, and the operation of all morbific and remedial agents when they affect parts that are distant from the direct seat of their action.—Rights of Authors p. 912.

5. "The experiments of Dr. Philip tend to show that distinct parts of the sympathetic, and the movements dependent upon them,

* *Continuous influence* of these Institutes (§ 129 *e*, *f*, 498 *a*).

as of the heart, for example, do not derive their nervous influence from distinct regions of the brain and spinal cord; but, on the contrary, that the whole brain and spinal cord, or every part of them, can exert an influence on the motions of the heart," of the capillary blood-vessels, of the intestinal canal, &c. (§ 476–492, 494 *d*).

6. Next follows a most important physiological law, when applied pathologically and therapeutically, and by which I explain the continued operation of morbific and remedial agents long after the cessation of their direct action.

"The movements excited in organs which are under the influence of the sympathetic nerve, by irritation applied to them or to their nerves, are not transitory and momentary contractions. They are either *enduring contractions*, or they consist of a *long-continued modification* of the ordinary rhythmic action of the organ. Hence, in these organs, the reaction consequent on the irritation *is entirely of longer duration than the action of the stimulus*" (§ 514 *g*, 516, no. 2, *c*, 487 *e*).

Now, what is true of the nervous influence as it respects its effect on the great organs is, according to the experiments of Dr. Philip, and others, equally so of the small blood-vessels, and the vessels of secretion, and as a consequence, of their products.

The foregoing law is founded upon experiments in which the irritation produced by agents is not directly morbific, such as galvanism and mechanical irritants. If such causes, therefore, will continue to derange the actions of the organic viscera after the operation of the causes is withdrawn, those which are truly morbific will continue in action longer, and establish disease more permanently through the same channel. And so of remedial agents. The law is shown, naturally, by the unabated contraction of the sphincter muscles after the evacuation of urine and of fecal matter (See *Belladonna* &c., p. 674).

This physiological law, therefore, is of vast moment in interpreting the effects of remedial agents, corresponds with that natural condition which is set forth in § 514, *g*, shows us how the influence of an emetic or cathartic may continue to be felt by the lungs, the brain, &c., long after their most characteristic effects are over; or how an uninterrupted and cumulative action of the foregoing nature may be maintained by small and repeated doses of mercury, antimony, &c., or by the peculiar change which leeches establish in the vessels to which they are applied, and, finally, how a morbific cause of yet other specific virtues may, by its momentary action on the mucous tissue of the stomach, or lungs, &c., be kept up in those tissues long after the remote cause is withdrawn, and progressively shed a morbific influence over all the organs of the body (§ 150, 498 *f*, 545, 549, 550, 558 *a*, 559, 666). The impression is maintained, in all the cases, upon the organic constitution of the organs immediately impressed, for an indefinite time after the agents themselves have ceased their operation. While that impression remains the influence which has been thus exerted continues to modify, more or less, the vital nature of the parts, and to be reflected with various effect upon distant organs. We have seen the simple physiological elements operating through the combined media of the cerebro-spinal and sympathetic systems, in § 514, *f*, *g*, as it respects the permanent contraction of the sphincter muscles, and in the explanation which I have given of the persistence of their contraction after the expulsion of the urine and fæces.

Now, that principle which physiologists have limited to an explanation of the natural phenomena in relation to the sphincters is most extensively applicable in resolving the problems of disease and of remedial influences, and I shall carry it, in connection with the foregoing law, far into the labyrinth of organic life, as it may fall under the cognizance of the pathologist and therapeutist. In the aspect, alone, of its bearing upon the amount and frequency of doses, &c., in the treatment of disease, the law is of incalculable magnitude (§ 857). The same impressions which are left upon the bladder and rectum after the evacuation of their contents, and which continue to propagate reflex nervous actions to the sphincter muscles, and thus maintain them in a state of contraction till the urine or the fæces again accumulate, equally appertain to morbific and remedial agents. Hence I deduce an important practical rule for the regulation of doses, the frequency of their repetition, the order of their application, &c., according to the nature of disease, the nature of the agents employed, the duration of their effect, &c.; all of which is amply sustained by the results of practice, especially those which so constantly accrue from excessive doses, and their repetition before the influences of the preceding shall have duly abated, or where other means should have been substituted. There is nothing, I say, of greater practical importance in the whole circuit of medicine than what is involved in this section, and in those which I shall have brought to its illustration. We must attend to the physiological facts. The effects of mistaken practice are entirely insufficient to enlighten the understanding. Physiology must be brought back as the basis of pathology, the groundwork of therapeutics; keeping ever before us those natural laws through which the evil and the good of practical medicine are essentially determined. However various the causes and the phenomena, a concurrence of principle and of laws obtains among the whole; which is the surest proof that the doctrines here taught have their deep foundation in nature (§ 237). There is nothing that can assure us more emphatically of the importance of sweeping away the chemical and physical doctrines of life, of disease, of therapeutics, than the facts about which I am now interested, and the mischief which has arisen either from removing pathology and therapeutics from their proper foundation, or in deriving their foundation from the laboratory of the chemist (§ 5½ *a*, 350½, 350¾, 819, &c.).—Note Ff p. 1135.

7. The next following law shows that the organs of organic life are essentially a system by themselves, that their actions are carried on by their own inherent powers, and are essentially independent of the nerves, and that the great office of the sympathetic nerve is to provide a stimulus, and *animalize* organic compounds. It will be seen, however, that a common error occurs, that "*the immediate cause of the involuntary motions lies in the sympathetic nerve*" (§ 516, no. 2).

"The immediate cause of the involuntary motions, and the cause of their type, lies neither in the brain nor in the spinal cord, but in the sympathetic nerve itself. Even the influence of the ganglia is not necessary. The branches of the sympathetic going to an organ may be entirely removed, the twigs distributed to the substance of the organ only being left, and the motions will be maintained as before, the reciprocal action between the muscular fibres and these ultimate nervous twigs being apparently adequate to their production."*

* See Note Bb p. 1131.

The phenomena are the same in plants. They depend, not on the nervous power, but on the organic properties of every part. This appears from Müller himself, who says that, "to excite the motion of the leaflets and petioles of the mimosa, it is not necessary that either the intumescence, or even the leaves, should be touched. The *stimulus* may be applied to a more or less distant part" (§ 184, 207, 208, 233, 257, 490, 502, 524, no. 2). Had Müller said the *exciting* instead of the "immediate cause," there would have been less objection; but the present case is like that in § 264, 498 *e*, 516 *c*, 1042.

8. Now follows the great law, that, notwithstanding the foregoing separate nature of the organic properties and their essential independence of the nervous power, the organic properties are constantly *influenced* through the cerebro-spinal and sympathetic systems. What is said, however, of the "extreme branches of the sympathetic" must be regarded as erroneous (no. 7), though it be certain that influences may be determined by reflex action through the ganglia and plexuses of the sympathetic nerve (§ 459). The law is thus expressed by Müller:

"Although, from the foregoing observations (no. 7), it is certain that the extreme minute branches of the sympathetic have still the power of regulating the movements of the parts not subject to the will (when such parts are abstracted from the body), yet it is not less true that both the brain and spinal cord, and the ganglia themselves, when in a state of irritation, exert an influence on these movements as long as the contractile organs are connected with them through the medium of the nerves. The brain and spinal cord are, however, also to be regarded as the source of the power of the sympathetic itself, which would, without them, become exhausted" (§ 473 *c*, 524, no. 6).

The last clause of the foregoing law is inapplicable to the fœtus without brain and spinal cord (§ 493 *c*). As to the exciting cause of motion in the extirpated heart and intestine, the question is important only as it relates to the proof that motion depends essentially upon properties inherent in the tissues, and as involving an implication that the sympathetic nerve embraces in its minute ramifications centres of reflex nervous actions. In its larger branches such centres probably exist (§ 262, 263, 473 *c*, 498 *e*, 516, nos. 2, 3, 1042).

The preceding law involves the sum of reflected nervous actions, of the operation of the passions, and of other direct cerebro-spinal influences on the organic viscera (§ 227, 230).

9. I would vary the phraseology of the following law, to render it more conformable with the facts. I do not believe that the sympathetic nerve is any longer charged with the influence derived from the brain and spinal cord than during its connection with those parts. So far as this nerve manifests an influence after that connection is severed, it is itself the source of that influence; and this conclusion is sustained by the fœtus without brain or spinal cord (§ 1038).

"It results," says Müller, "from the fact already stated (nos. 7 and 8), that the sympathetic nerve is charged, as it were, with nervous power by the brain and spinal cord, which may be regarded as the sources of nervous influence; but that, when once charged, it continues to emit this influence in the manner peculiar to itself, even when the farther supply is, for a time, diminished" (§ 516, nos. 7 and 8; § 520, 524, no. 5).

If the "fact" show anything, it is a certain independence of the

sympathetic of the cerebro-spinal system, which becomes strongly pronounced when the latter is wanting in the fœtal state, or when deranged in some chronic maladies.

10. The next law shows that the action of agents is incomparably greater upon the minute terminations of the nerves than upon their trunks. It is equally applicable to the cerebro-spinal as to the sympathetic. Thus:

"The influence of narcotics locally applied to the sympathetic nerve, does not extend to the distant organs which the nerve supplies; but these organs may be paralyzed by the direct narcotization of the minute nervous fibrils which are distributed to them."

The principle is general, extending to all other agents, and has been misapplied by Müller, and many others, to sustain the humoral pathology (§ 826, *d*. *Med. and Phys. Comm.*, vol. i., p. 563, 564).

11. The next following law will be seen to be important in interpreting some of the various phenomena of sympathy, when they originate in the sympathetic nerve. Thus:

"The laws of reflection (in the cerebro-spinal system) stated in the third chapter of this section prevail, likewise, in the actions of the sympathetic nerve. Strong impressions on parts supplied by the sympathetic nerve may be propagated to the spinal cord [and brain], and give rise to motions of parts which derive their nerves from the cerebro-spinal system."

As an illustration of this law, "Volkmann has observed convulsions of the body produced by irritating the intestines of a decapitated frog."

With the head on, and in animals more susceptible than frogs, the foregoing law becomes extensively applicable to agents applied to the intestinal canal, or other viscera that are especially supplied by the sympathetic nerve. Thus, nux vomica produces spasmodic action of the voluntary muscles, while opium, &c., relieves them in the same way. Indeed, it is well ascertained that all the spasmodic movements of the voluntary and respiratory muscles that arise from affections of the abdominal organs depend upon irritations transmitted to the brain and spinal cord, and their subsequent reflection upon cerebro-spinal nerves. Hence, also, the action of the abdominal muscles in the vomiting excited by irritation of the intestines, by irritation of the kidneys, of the uterus, &c. And so of the natural movements of the respiratory muscles (§ 500, 889 *g*, 891½ *g*, *k*, 903 *a*, 902 *g*).

12. "Impressions on parts of which the nerves are derived from the sympathetic are communicated to the spinal cord and brain, and excite the motor influence of the sympathetic nerve by reflection."

The foregoing law is an extension of no. 4, and is the most important of well-ascertained laws in medicine, as explaining all the sympathetic influences of disease, all the influences of remedial and morbific agents exerted upon parts distant from the seat of their direct action; except such phenomena as may also fall more or less under the laws 11 and 13, in connection with which this law should be considered.—(*Med. and Phys. Comm.*, vol. i., p. 569–572.)*

13. "Reflected action of the sympathetic, from an impression communicated to the spinal cord by cerebro-spinal nerves, is a frequent occurrence" (§ 893 *a*, *c*).

The "frequency of the occurrence" is such, that it is through the

* See Rights of Authors, p. 912.

foregoing law, and the 12th, that remedial agents operate upon the organic system when applied to the skin, that diseases of the skin affect the abdominal viscera, that the contact of cold air suddenly increases the excretion, or the discharge, of urine, &c. The 12th law is involved, since both the cerebro-spinal and sympathetic nerves of the skin are the media of transmitted impressions. The chain of involved influences is of the highest importance, pathologically and therapeutically. As one of a thousand illustrations, if tobacco applied to the skin produce vomiting the effect is first propagated to the nervous centres, from which it is reflected upon the stomach through the motor fibres of the par vagum and sympathetic nerve. This irritation of the stomach is equivalent to a direct impression from tobacco upon its mucous tissue (§ 503). It is then returned to the nervous centres through the sensitive fibres of the par vagum and sympathetic nerve, and reflected upon the respiratory muscles through the motor nerves of those organs (§ 113, 224, 226, 475½, 500 *k*, 893, 893½).

But there are other profound influences, and other circles of sympathy simultaneously established. The organic properties of the stomach are affected, reflex nervous actions are reverberated upon the skin, displayed in the heart and blood-vessels, in the liver, and other important organic viscera, while these influences also mutually react upon the several organs, respectively, and involve other parts, such as the uterus, the kidneys, the bladder, the voluntary muscles, the sphincters, the senses, the mind, &c., in the deep complexity of results. And all this astonishing consecutive series of effects, moving forward under the most precise and fundamental laws of nature, and all the work of a moment, is set in motion by the simple application of a leaf of tobacco to the sole of the foot (§ 502, 902 *g*).

517. Finally, the nervous power may be determined upon the organic properties of the brain, or of any part of the nervous system, by physical and mental causes, with much of the variety of effect which it produces on other parts (§ 230, 512, 1040).—NOTE Q p. 1122.

518, *a*. "In certain organs, which are subject to the influence of the sympathetic and of the cerebro-spinal nerves at the same time, a voluntary influence seems to be exerted only after the long continuance of a centripetal or sensitive impression."

So far as this principle is operative, it goes to demonstrate the remarkable peculiarities, the versatile and complex nature, of the functions of the nervous system (§ 500, *j* and *k*). The urinary bladder, for example, which is under the influence of the will, presents the following phenomenon: "The will does not come into operation until a considerable accumulation of urine has taken place; in other words, not until the fluid has made a long-continued impression on the sensitive nerves of the bladder, and through the medium of these upon the cerebro-spinal axis" (§ 500, *e*).

518, *b*. Analogies evidently occur in the viscera over which the will has no control, while the facts are illustrated by the principle as ascertained in the foregoing manner; such, for example, as the long incubation of miasmata, of the hydrophobic virus, mercurial influences, &c., and the sudden accession of the phenomena to which they respectively give rise (§ 500 *e*, 514 *g*, 516, no. 6). In sections 500, *j* and *k*, are some remarkable facts which will deter us from rejecting difficult problems in sympathy (§ 473, no. 6, 523, nos. 6 and 7).

519. The following law is a farther exemplification of the foregoing comments (§ 518, *b*), and should be considered in connection with the 11th and 12th laws. Thus:

"Many parts which are supplied by the sympathetic nerve, and capable of involuntary motion only, become associated with the motions of parts subject to volition; a part of the voluntary motor influence being communicated involuntarily to them; just as in the associate motions of the voluntary muscles."

Of this, examples are afforded by the iris, the vesicula seminalis, and intestine (§ 500, *c*). It is in this way the will affects the iris.

520. The problem is propounded by Müller, "Can reflex phenomena be produced in the sympathetic nerve through the influence of the ganglia, and independently of the brain and spinal cord?"

He is disposed to answer the question negatively, and observes that, "We are at present entirely ignorant as to whether irritations in one organ ever, through the medium of the sympathetic, give rise to sympathetic movements in another." And yet when he comes to reason from the phenomena of nature, he remarks that, "in many cases, it is probable that the reflections are produced through the medium of the sympathetic alone;" and again, that in such cases, "it is probable that the sympathetic nerve alone is engaged in the production of the phenomena." This is enforced by the considerations, that, "the peculiarity of the organic or sympathetic nerves, namely, the difficulty of distinguishing either origin or termination of them, their want of (definite) arrangement into trunks and branches, and the increase in their course which they frequently undergo, is certainly in favor of their actions being propagated in all directions *from the central points of the ganglia*."

This was the old doctrine, which concerned itself mostly about the sympathetic nerve, and the fact is distinctly evinced by many of the phenomena of contiguous sympathy (§ 497), and by the fœtus without brain and spinal cord. It seems, also, to have been shown by the experiments of Henlè, Grangier, and Valentin, upon the intestines. But careful attention is necessary, in these cases, to distinguish what is due alone to the independent organic properties of any part, from that which is owing to an influence exerted upon those properties by the nervous power (§ 222, &c., 507, 516, nos. 7 and 8, 1038). In the former case other stimuli operate (§ 490, 498 *e*).

521. "It is not proved, and several facts have been observed which are opposed to the belief, that the ganglia can exert an insulating action so as to impede the transmission of motor influence from the brain and spinal cord" (§ 523, no. 4).

All the phenomena of sympathy in organic life appear to be opposed to this belief.

522. "It is not certain that the ganglia are the cause of the parts supplied by the sympathetic nerve being withdrawn from the influence of the will."

It is probable that the cause is inscrutable, since it is owing to peculiarities in the vital as well as mechanical constitution of the two systems of nerves. We see, however, that influences are as readily transmitted from the brain to the organic viscera as the will operates on the voluntary muscles; and while the passions scarcely operate in animal life, they have a powerful and rapid effect on organic.

Laws of the Sensitive Functions of the Sympathetic Nerve.

523. 1. "The sensations in parts, the nerves of which belong to the sympathetic system, are faint, indistinct, and undefined; distinct and defined sensations being excited in them only by violent causes of irritation" (§ 201, *b*).

2. "The sensitive impressions received by the sympathetic nerve, although conveyed to the cerebro-spinal axis, may not be perceived by the sensorium" (§ 199½, 451).

3. "The impressions which give rise to reflex motions, when conveyed to the spinal cord by the sympathetic nerve, are, in most instances, not productive of sensations; while those impressions which are received by cerebro-spinal nerves always give rise to sensations" in natural states. The *reflex* is our *sympathetic sensation* (§ 201, 451).

4. "The ganglia of the sympathetic nerve do not prevent the transmission of centripetal actions in that nerve to the spinal cord. They have not an insulating power over its centripetal currents" (§ 521, 1038).

5. "The ganglia are likewise not the cause of the impressions on the sympathetic nerve being unattended with true sensation."

6. "In many cases, irritation of a violent nature in organs supplied by the sympathetic nerve gives rise to sensations in those parts. In other cases, the irritation being less violent, the sensations in the parts affected are indistinct, while distinct sensations are present *in other parts supplied with cerebro-spinal nerves*" (§ 518, *b*).

We have examples of the first kind in inflammations of the intestines and liver; of those of the second kind, in the troublesome itching of the nose and anus in affections of the intestinal canal, and pain of the shoulder in hepatic and cardiac diseases, of itching of the glans penis in chronic affections of the bladder and kidneys.

7. "The secondary sensations in cerebro-spinal nerves, consequent on irritation of the branches of the sympathetic, occur especially at the extreme parts of the organs affected."

Morbid states of the stomach produce a sense of irritation in the throat; and nothing is more common than obstinate inflammation of the mucous tissue of the fauces from gastric derangements, which are not inflammatory.* In all these cases, remote and continuous sympathy are more or less in combined operation. An ignorance of the laws which govern in such instances leads many physicians to apply their remedies to the parts where the sensation is felt, or the inflammation appears. There is also a special sympathy between the extremities of the intestinal mucous membrane. Smoking, for instance, often brings on an attack of the piles; though an intermediate chain of morbific influences is also propagated to the anus through the stomach and liver (§ 498 *f*, 514 *h*, 689 *l*).

Laws of the Organic Functions of the Sympathetic Nerve.

524, *a*. 1. "When, in consequence of impressions on sensitive nerves, secretions take place in distant parts, the brain and spinal cord are probably the medium of communication." Thus, "impressions on internal mucous membranes, as by hot drinks, frequently give rise immediately to a general sweat."

* *Diphtheria* and *Fothergill's Sore-throat* are merely sympathetic results of profound, insidious, venous congestion of the abdominal organs (§ 689 *l*).—Note Kk p. 1140.

This is precisely similar to what I have said of the effect of food in lighting up a warmth in a cold skin (§ 512).

The foregoing law is true, in a general sense (§ 455, 458, 459, 490 493 *b*, 516, nos. 7 and 8). It lies at the foundation of the whole doctrine which I have projected of alterative reflex action, through which I interpret all diseases that spring up as consequences of each other, and the operation of morbific and remedial agents upon parts remote from the seat of their direct influence. It is variously expressed in the preceding laws.

If hot water operate upon the stomach and transmit its influence through the cerebro-spinal and sympathetic system to the whole surface of the body, it is clearly in the same way that tartarized antimony produces a sweat over the whole cutaneous organ when it determines nausea, or the act of vomiting, and therefore, also, when it acts upon the stomach in a more insensible manner. And so of the remote influences of other remedies, or of morbific agents, or of gastric, or any other primary disease. If it be the principle as laid down physiologically, it must be equally the same for analogous effects in disease, or in its treatment.—See RIGHTS OF AUTHORS, p. 913.

2. "There prevails a consent of action between the different parts of a secreting membrane. Thus, the state of one spot influences the condition of the whole extent of a mucous membrane" (§ 498 *f*, 516, nos. 2, 3, and 7).

This is the *continuous* sympathy as expounded in this work. It is more or less manifested in most of the diseases of all tissues, and although not a function of the sympathetic nerve, I have retained the law under that denomination (§ 141, 498, 520, 923).

3. "A particular state of one organ, such as inflammation, or a secreting action in it, often causes the production of a similar state in other parts."

This proposition is intended in a specific, not in the general sense in which disease of one part gives rise, by reflex action, to *diverse* affections of other parts. It refers to peculiar states of disease in which remote sympathy is often remarkably characterized. Thus, "inflammation of the testicle may be replaced by inflammation of the parotid; erysipelatous inflammation of the skin may be transferred to the membranes of the brain; suppression of the secretion of one organ may give rise to increased secretion in another." So of the extension of rheumatism and gout from one part to another of very different organization (§ 142, 893 *n*, 905 *a*).

524, *b*. Where sympathies of the foregoing nature arise, there is often a special relation of natural functions between the respective parts, as between the uterus and mammæ. Or such relation appears to be pronounced only by morbid states, as between the parotid and testis, and the parotid and mammæ, in the mumps (§ 142).

524, *c*. As resulting from the foregoing (no. 3), though apparently the reverse of it, we have the important reflex influences, that when disease springs up in distant parts as a consequence of some affection of other parts, the secondary affection often proves curative of the primary one. It is the same, in principle, as when blisters, setons, &c., relieve some internal malady. Many sympathetic diseases have, as it were, a great final cause, as a part of the natural constitution of animals. The ordinary forms of inflammation which supervene on

venous congestion often relieve a more formidable affection of the veins (§ 803, 804, 905. Also, *Med. and Phys. Comm.*, vol. ii., p. 519–524). Inflammation of the bronchial mucous membrane, or of the pleura, supervening on pneumonia, may assuage the latter affection. Phthisis, supervening on gastric disease, sometimes removes the latter condition. Eruptions of the skin relieve disease of the internal viscera. The hepatic action which leads to morbid redundances of bile mitigates cerebral or other congestions and inflammations, and the effusion relieves the liver; while it is the tendency of inflammation of all parts to relieve itself by some morbid product, whether the disease be primary or secondary. Nature, in these cases, has supplied indications for the hand of art; and, instead of waiting for the indirect and spontaneous course, we should abstract blood, or hasten to establish those changes which result in increased secretions, &c. While, also, we are accomplishing these results, which, abstractedly considered, are depletive, we are acting, at the same time, upon the diseased properties, either by a direct impression upon them by the remedies, or indirectly by reflex nervous action (§ 503). But this is mainly true of the natural processes as it respects spontaneous hemorrhage. All the other natural effusions are greatly wanting in those direct remedial effects which are exerted by therapeutical agents that lead to similar products.

"The principle of the balance of sympathy teaches us how we must avoid aggravating the morbid condition of one organ by the means which we apply to another; but it also teaches us how we may produce a change in the state of one organ directly inaccessible to us by effecting an appropriate change in another."—Müller. Here Müller is any thing but a humoralist, as, also, throughout his disquisition on the laws of sympathy; though in other places he lays down the broad doctrine that morbific and remedial agents produce their effects by absorption into the circulation (§ 494 *dd*, 514½ *b*. Also, *Med. and Phys. Comm.*, vol. i., p. 563–571).

524, *d*. It might seem, at first glance, that the fact of the vital properties and actions being liable to disease is inconsistent with the great laws of recuperation and self-preservation. But it is not so; since morbific agents being permitted, their occasional deleterious action grows out of the natural constitution of the properties of life, which is physiologically designed for the healthy processes. That these processes may be carried on, the properties of life must be susceptible of being acted upon by foreign agents, as food, &c., and universally by the blood. They must also be liable to modifications in their nature, that certain specific functions may be instituted from time to time, as the processes of gestation, lactation, &c., and the powers of all other parts must be so constituted as to adapt themselves to these transient modifications. And so of other changes, as from infancy to childhood, from childhood to puberty, &c. (§ 153–159). Now the changes which arise in disease are analogous to those of gestation, lactation, and more remotely to those which occur at puberty; and they are, therefore, necessary consequences of the natural and essential constitution of the vital properties when noxious agents act upon them. We therefore return again to our proposition that it is even a necessary consequence of the final cause of the adaptation of the properties of life to the influence of salutary agents. And hence, also, the natu-

ral law of adaptation (§ 136) extends to morbid states of the system; being, for example, the principle already adverted to, which protects the general system against those morbid changes in the blood that ensue upon local diseases, and diseased parts against the irritation of their morbid products (§ 74, 129, 137 *c*, 143 *c*, 150–152, 155, 156, 387, 524 *c*, 944 *c*, 980, 1019, 847–850).

4. "The ganglia appear to be the central parts from which the vegetative influence is distributed to the different organs."

5. "This radiating influence appears to be, in a certain degree, independent of the brain and spinal cord" (§ 520, 516, no. 9).

6. "It appears, however, that the brain and spinal cord are the *main* source whence the power of the organic nerves is gradually ren ovated" (§ 1038).

7. The sympathetic nerve modifies organic functions and their products, and supplies the stimulus of the nervous power to muscular fibre in organic life (§ 224, 455 *a*). Every organ, through this channel, is rendered sensitive to the condition of each other, and they so interchange their influences upon each, that the whole are maintained in those relative states of action which are most conducive to the good of the whole. From the exquisite susceptibility of the nervous power, and of sympathetic sensibility, which is so conspicuous in this function, arise those disturbances that are inflicted by organs upon each other, and the reflected influences of remedial and morbific agents (§ 113, 224, 455, 461, 461½, 475½, 487 *h*, 500 *g*, 516 *d*, nos. 7–9, 647½, 893, 893½).

SYMPATHIES OF THE INDIVIDUAL TISSUES—REFLEX AND CONTINUOUS.

Sympathies of Similar Tissues.

525, *a*. Enough, perhaps, has been said upon this subject(§ 85–117, 133–143). We have seen that tissues of a similar vital constitution have the greatest tendency to sympathize with each other; but it is not necessary that the secondary disease should be of the same nature as the primary, though such is apt to be the case (§ 140, 141, 149–152).

The most frequent instances of morbid sympathies in tissues of the same nature, but remote from each other, occur in the following order (§ 162):

1. The venous tissue, in the form of venous congestion (§ 786, &c.).
2. The fibrous tissue, as in rheumatic inflammation.
3. The serous tissue, as seen, especially, in dropsical affections.
4. The mucous tissue.
5. The cellular tissue.
6. The lymphatic tissue.
7. The nervous tissue.
8. The arterial tissue.
9. The muscular tissue.
10. The osseous and cartilaginous tissues.

525, *b*. When similar tissues sympathize with each other, the sympathetic disease and its phenomena are apt to be similar to the primary affection; while, in the case of sympathies arising among different tissues, the phenomena are different in each, even though the primary and secondary affections be of the same general nature, as,

however, they are not wont to be. When like tissues sympathize with each other, the diseases and the phenomena are most analogous, because the same tissue in different compound organs has, respectively, modifications of the organic properties that are more alike than those of different tissues. And hence, mainly, the greater difference between the primary and secondary diseases of different tissues (§ 133–140).

525, *c*. When disease springs up in tissues of the same organization, but remote from each other, as in rheumatic inflammation of the fibrous tissues, for example, the primary affection often exists in some other part or parts, as the digestive organs, and is generally of a different character from the secondary affection. In these cases, which are common, the successive secondary affections may be more owing to reflex influences of the parts primarily diseased than to the sympathetic influence of the tissue secondarily affected upon other parts of its own denomination. This is an important practical consideration, for upon its just estimate will depend much of the treatment in any given case of disease (§ 902 *m*, 905). It is also equally true that the sympathetic affections which supervene among compound organs are apt to be more or less different from the primary affection.

526, *a*. Tissues morbidly affected sympathize, continuously, in their several parts, most readily in the following order (§ 133–136, 498):

1. The venous tissue, in congestion or sub-inflammation.
2. The lymphatic tissue.
3. The cellular tissue.
4. The mucous tissue.
5. The fibrous tissue.
6. The serous tissue.
7. The glandular tissue.
8. The dermoid tissue.
9. The nervous tissue.
10. The muscular tissue.
11. The cartilaginous and osseous tissues.
12. The arterial tissue.

Owing to the peculiar vital constitution of each tissue, disease is apt to be confined to that which it first invades, but to disturb the condition of other parts with which it may be associated (§ 133–136). There are, indeed, some striking exceptions to the general rule; as, rheumatic inflammation of the ligaments is often propagated to the heart, and sometimes to a mucous tissue. Inflammation of the pulmonary air-cells is very apt to be extended to the serous tissue of the lungs, or inflammation of the liver to its investing membrane. Indeed, the serous membranes generally participate in the morbid states of the other tissues with which they are associated; nor can much intensity of disease affect any tissue without disturbing, more or less, the condition of its associate tissues. But there is much variety in these respects, even in continuous organs, as between the stomach and the small and large intestines. If the mucous coat of the small intestine be actively inflamed, it is frequently the cause of a like condition in the peritoneal coat, when the mucous inflammation may subside as a sympathetic consequence; thus representing the double operation of the law in § 524, no. 3. But, however severe-

ly the mucous coat of the stomach may be affected with inflammation, the disease is rarely propagated to the serous tissue of the organ, but far more readily to the serous or other tissues of the lungs, &c.

In respect to the arterial tissue, when we regard the extreme and capillary series as the instruments of all diseases, and, therefore, always involved in morbid action in the diseased states of all other tissues, it must rank as the first in its liability to continuous and remote sympathetic influences (§ 1040).

The arterial tissue itself is but little subject to other conditions of morbid action; and when the large arteries become inflamed in any part, the disease remains very circumscribed. They have, also, no great action in their natural state; it being their office, mainly, to serve as conduits for the blood. Nevertheless, they are constantly liable to sympathetic irritations, either by continuous influence or reflected nervous action. The next series, or the capillary arteries, are reservoirs of blood to the extreme vessels; and to meet the exigencies of this function, they have their vital properties and actions more strongly pronounced, and are readily and manifestly influenced by the nervous power, as abundantly shown in blushing, &c. (§ 512, *b*). Hence, from this natural, physiological constitution, this series of the arterial system is more liable than the larger to irritations and augmented actions, as manifested in most inflammations (§ 715–719).

We come next to the extreme series, in which the capillary arteries terminate; and here we find the vital properties developed in an eminent degree. This is known from their being the essential instruments of all healthy and morbid processes; and the changes in their phenomena and products during disease evince the rapidity and great extent in which these properties and actions may be modified by the nervous power, and which are brought about in an instant of time when that power is developed by the mind (§ 227, 500, 516 *d*). Reflex nervous action plays an incessant and extensive round among this extreme series of vessels, both in health and disease. A breath of cold air may arrest the secretion of sweat, and simultaneously determine an increased flow of urine, or fear will as suddenly augment both excretions. Coming to disease, and the influence of remedial agents, this natural relationship of the extreme vessels, and the same physiological principle, are at the foundation of the principal philosophy. Indeed, the organic properties being now more susceptible than in health, and the nervous power more intensely developed by morbific and remedial agents, its operation must be more rapid, extensive, and profound, in the latter than the former case. Hence, in part, inflammations, &c., are liable to spring up in rapid succession in various remote organs, after their invasion of any one part (§ 1056).

526, *b*. Next, as to the venous tissue. Here the sympathies are great, both of the remote and continuous kind, particularly the latter (§ 498). It is especially through the natural physiological sympathies of the veins, that I have endeavored to show how they co-operate in circulating the blood, as also the error of the physical doctrine of venous congestion, which supposed that this most prevalent and fatal disease depends on obstacles to the circulation and consequent stagnation of the blood. I have, therefore, endeavored to expound the pathology of this affection upon purely vital grounds, and in conformity with physiological laws (§ 786, &c.). The main physiological prin-

ciple of a sympathetic nature, however, should be stated in connection with the subject before us. The venous radicles possess a vigorous action which is constantly influenced, through continuous sympathy, by the corresponding state of the capillary arteries, and by the quantities of blood transmitted to them; and that the trunks of the veins have a most visible action is shown by their rapid contraction and dilatation when cold or heat may operate upon the skin. This action is simultaneous, or nearly so, over a large extent of the veins, and is the result of continuous sympathy with the arterial system, as well as dependent on the quantities of blood transmitted and upon reflex nervous action. But, when an increased quantity is transmitted, the enlargement of the veins is in no respect mechanical, but produced, in part, by the greater impression which is thus made upon the exquisite susceptibility of the organic properties of the veins.

From these few remarks as to the vital endowments of the veins, and of the active functions they perform, it is evident that they must be quite liable to morbific influences, and that remote and continuous sympathy of a morbid nature must have a ready operation among them (§ 74, 117, 137, 155, 156, 387, 422, 514 *h*, 524 *d*).

526, *c*. In respect to the lymphatic system, the principle of continuous sympathy, as in the veins, is strongly exhibited under the influence of irritating agents. If a lymphatic become inflamed at some point in the skin, the inflammation may extend rapidly along the course of the vessel, while the glands, also, will take on the same condition. Here is the great bulwark of humoralism. Here it is, and in the lacteals, that the humoral pathologists suppose that morbific agents enter the circulation and corrupt the blood, or remedial ones are equally absorbed, and transmute it from a morbid to a healthy state! But, since the needle, whose prick may propagate an extensive inflammation along the course of a lymphatic vessel, is not absorbed, nor the leeches which remove the inflammation, we may rest satisfied that the poison of the viper, of the mad dog, &c., do not produce their effects upon the principle of absorption (§ 268, &c. Also, *Med. and Phys. Comm.*, vol. i., p. 480–514).—Also § 494 *a–e*, 514 *g*, 828–829.

Diseases of the lymphatic glands are especially owing to constitutional predispositions, as in scrofula. When disease is developed in any one or more of these glands, others readily take on the same state of inflammation. While, therefore, under special circumstances, remote sympathy predominates in the lymphatic glands, the continuous form is mostly witnessed in the lymphatic vessels.

In the great plan of organic Design, those inlets of the absorbent system, the lacteals, are greatly exempt from morbific influences.

526, *d*. Sympathies between the brain, spinal cord, and nerves, and between the nerves themselves, are more or less in progress, in the natural state of the body. Their phenomena, however, are not very manifest, unless the nerves of some particular part sustain an irritation (§ 501). Thus, the irritation from stone in the bladder occasions morbid sensations in the penis. Other examples occur in § 523, no. 6. When disease is produced, sympathetically, in the brain, or spinal cord, or nerves, by morbid states of other organs, it is not due, as supposed by Müller, to sympathy with the nerves of the parts so affected, but to the morbid change in the general vital constitution of such parts. In this respect, the sympathies of the nervous system with other or-

gans observe the same laws as apply to other sympathizing parts both as to disease and its resulting reflex nervous actions (§ 230).

It is difficult to analyze the sympathies which occur, specifically, in the nervous tissue, since it is the medium through which remote sympathies take place. Continuous sympathy we know to be of very limited extent, and have every reason to believe that the great final cause of the nervous system is protected by an unusual exemption of this system, especially such parts as supply the organic viscera, from severe morbid conditions, which never fail to inflict great injuries upon other parts. It is also true that diseased conditions of the nervous tissue are not easily reached by remedial agents; and the injury they inflict on other parts constantly reacts in maintaining morbid states of the nervous tissue.

The sympathies of which I am speaking refer to the changes which may be produced in the organic state of the nervous system, not to the transmission of impressions, nor to the development and influences of the nervous power, excepting so far as this power may be productive of direct changes in the organic properties and actions of the nervous tissue (§ 230). The general convulsions that arise from irritation of the nervous expanse in the intestinal canal, or from teething, &c., imply no absolute disease of any part of the nervous system; but only a strong development of the nervous power, and its forcible reflex action upon the muscles that may be spasmodically affected (§ 223–226, 233, 500, 891½ *b*, *g*, *k*, 893½, 903, 984 *b*).—Note Q p. 1122.

I therefore think that authors, as Marshall Hall, for example, in his work on the Nervous System, are wrong in considering "all convulsive affections to be *diseases* of the true spinal or excito-motory system." On the contrary, I apprehend that in most of these cases there is no actual disease of any part of the nervous system; and it is of no little practical importance that this question should be rightly settled. The "principal causes," says Dr. Hall, "are dental irritation acting through the fifth nerve; gastric irritation acting through the pneumogastric; and intestinal irritation acting through the spinal nerves."

Now, we have variously seen how the nervous power may be preternaturally excited, and determined with various effect upon the organs of organic and animal life; being so constituted as to be exquisitely susceptible to a vast variety of natural causes (§ 226, 227, 500). The muscles of animal life are naturally under the powerful influence of the nerves; this being a special ordination in relation to the nervous power and the mobility of muscles of animal life, to enable the will to determine the nervous power so as to produce voluntary motion, and other causes to render it subservient to respiration (§ 205, 208, 226, 233, 500 *c*). Hence convulsions readily spring up; while, from the nervous system being designed for vital objects in organic life, preternatural influences of the nervous power give rise to other phenomena in that division of life. Owing, also, to these constitutional peculiarities, as well as to the natural modifications of the vital properties of the animal muscles, the nervous power, when determined with violence upon them, rarely occasions disease; while in respect to the same properties in the organic system, where they have a different modification, and the nervous power a different physiological function, it readily proves morbific (§ 133–150, 452–456, 893½).

We have, therefore, all the elements that are necessary to show that

Dr. Hall's pathology is wrong. The convulsions to which he refers as actual diseases of the spinal system affect the muscles of animal life, upon which the will may operate with violence in an instant, or which are perpetually held in action by the nervous power for the performance of the respiratory movements, and to carry out the office of the sphincters. A slight irritation, therefore, propagated to the nervous centres may rouse these natural motions into irregular and more violent ones, without producing any more disease in the nerves or the muscles than is produced by the operation of the will, or by those causes which maintain the movements of respiration. Again, if a cerebro-spinal nerve be irritated, convulsions are produced, and the same is done by a shock of the electric fluid. Now, these results are exactly analogous to the natural convulsions which are supposed to depend on "disease of the true spinal system of nerves." If we analyze the supposed cases, the same conclusions will follow. When, in one case, the gum is lanced down upon the tooth, the convulsions may cease immediately. In another, or when the convulsions depend on gastric or intestinal irritation, a dose of morphia, or an emetic, or an enema, or warm bath, will generally remove the convulsions very speedily, and they are not apt to return (§ 893½).

Diseases of the membranes of the brain or spinal cord, or of the substance of the brain or of the spinal cord itself, do not often occasion convulsions; which, indeed, are commonly independent of any disease of the nervous system. When, however, they do give rise to convulsive movements, or when such result follows an affection of a nerve, as in traumatic tetanus, there is no morbid state sympathetically induced in any other part of the nervous system, but the convulsions are owing to a propagation of the nervous power upon the muscles as in the foregoing cases. Here, the disease of the nervous tissue is exactly equivalent, in developing the nervous power, to the irritation propagated to the nervous centres by dentition, intestinal irritation, &c. It sometimes happens, therefore, that a division of the affected nerve, in tetanus, will at once remove the spasms.

When, therefore, convulsions arise from dentition, or intestinal irritation, we apply our remedies to the gums, &c., and not to the spinal cord, or to its nerves. Such as may depend upon disease of the nervous centres, or of a nerve, are obstinate, and the treatment is then directed with a special reference to the part which may be thus affected. Here the nerve-action is *direct*, there *reflex* (§ 227, 500 *c*, *d*).

Here, also, we learn the importance of an intimate acquaintance with the laws of the nervous power, and of correct theory. Convulsive movements, under most circumstances, have a very similar character; and to ascertain their causes, we must apply ourselves to other symptoms and other considerations. Nevertheless, they are apt to have certain differences in some affections. Those of tetanus have the strongest peculiarities; and here there is a very limited state of disease at the wounded part, but idiopathic tetanus may depend upon intestinal disease. But, there is often a complete resemblance between the ordinary convulsions from dentition, and gastric, and intestinal irritation, and those of hysteria and epilepsy; whatever may be the exciting causes in either case. Since, therefore, it may be of the highest importance to ascertain the particular causes, we institute a diagnosis through other attending facts (§ 893½).

Sympathies of Dissimilar Tissues.

527, *a.* Morbific reflex nervous actions occur less frequently among organs of different organization than among many of those which are constituted alike, with the exception of the mucous tissue of the alimentary canal and other parts, and between the skin and other parts. Between these two organs and all others there is, on the part of the latter, the most intimate connection by reflex nervous actions, especially the mucous tissue of the stomach (§ 512); and it is through this natural relation, and the increased susceptibility of diseased parts, that remedial agents so readily exert their effects upon the diseases of all organs, when such agents are applied to the intestinal canal or to the skin (§ 113, 465, 516 *d*, nos. 12, 13, 889 *g*, 891½ *g*, *k*, 892 *g*, *h*, 893 *a*, *c*).

527, *b.* Morbific reflex nervous actions between the alimentary canal and other tissues are variously considered in the progress of this work. Those between the skin and other tissues deserve farther consideration in this place. Their predominance and intensity between that organ and the alimentary mucous tissue are shown in the dependence of a vast proportion of cutaneous eruptions upon primary disease of the latter tissue. There is great reason to believe that such is the fact even in relation to measles, scarlet fever, and small-pox, when it occurs spontaneously, and probably also in the inoculated form; though, in the last case, there must be first a reflected influence from the artificial pustule of the skin upon the intestinal mucous membrane, from whence the influence is propagated back to the whole surface of the body (§ 902, *m*). This construction, so opposed to the humoral pathology, is sustained by the analogy which is supplied by most other cutaneous affections, and by the direct fact that the eruption of scarlatina and of measles appears in the mucous membrane of the throat before it does upon the skin. The eruption, especially of measles, is apt to be preceded, also, by inflammation of the mucous tissue of the eye, the nose, and lungs, as well as by cough. But, as will have been seen, it is not necessary that the secondary, or sympathetic, disease should be like the primary; especially in parts that are dissimilar (§ 527, *d*). If this pathology as to the consecutive order of developments be true, it is of great practical importance; since it assures us that great care must be bestowed upon the intestinal mucous membrane, as a principal seat of the radiating morbific influences. But the severity of small-pox, &c., depends greatly upon the extent of the cutaneous affection, and its consequent reaction upon the abdominal organs (p. 347, § 516 *d*, no. 13); and hence the advantage of moderating the eruptions by local applications. Can humoralism explain? Why such definite periods of rise and decline (§ 654 *b*)?

Sympathies between the skin and kidneys are naturally instituted for special exigencies of the animal economy; but these organs are so constituted in their relative susceptibilities, that the great final cause of their physiological relations shall not be defeated by the propagation of morbific reflex nervous influences from one to the other (§ 422, &c.).

Sympathies between the mucous and serous tissues are comparatively rare in health, and, therefore, in disease. Since, also, the same principles, in a general sense, are concerned in the remote influences of remedial agents, we thus understand why medicine taken inwardly has so moderate an effect upon peritonitis, or pleuritis, &c.; and this

philosophy is clearly confirmed by the ready action of cold upon the skin in developing inflammation of the pleura, and by the manner in which that inflammation may be often overcome by blisters or other irritants applied to the skin. Indeed, so extensive are the natural sympathetic relations of the skin to most internal parts that there is scarcely an inflammation of an internal tissue or organ that may not be more or less mitigated by irritants applied over the neighboring surface, if the application be not prematurely made (§ 514 *d*, 893 *a*, *c*).

There is a very intimate sympathy between the fibrous membranes and the cartilaginous and osseous tissues, which leads to the determination of morbific reflex nervous influences among them (§ 141, *b*).

527, *c*. Sympathies of different tissues with each other, of much intensity, are more common in parts that are distant than among the tissues of one and the same compound organ.

527, *d*. When disorders arise among different tissues, they are, as I have said, apt to be more or less different from the primary affection, or if alike, their phenomena more variable than among tissues of the same organization (§ 525). The primary affections may be mild while the sympathetic are severe. This relative mildness and intensity is constantly seen in the supervention of inflammations and congestions in remote parts as consequences of some minor derangement of the stomach, or other digestive organs, and in the manner in which severe diseases of all parts are subdued by the action of remedial agents upon the stomach. So, again, the action of cold upon the skin induces, by reflex action, inflammation of any of the tissues of the lungs, or of the intestines, uterus, liver, ligaments, &c.; but here no actual disease is produced in the skin, and the morbific agent is also of a negative nature. Hence a difficulty, notwithstanding its importance, of detecting the original source when a complex series of sympathetic affections has ensued (§ 514 *d*, *h*, 527, *b*).

Sympathies of Individual Tissues in their Relation to each other in Compound Organs, and with entire Organs.

528. When any tissue of a compound organ becomes the seat of disease, the influence of such disease is felt, more or less, by all the tissues of such an organ, where the primary disease is at all severe; especially in the organs of organic life. The tissues, as we have seen, which are secondarily affected may or may not sustain the same character of disease as the original affection; and this will depend much upon the nature of the organ. The sympathies, for instance, between the different tissues of the lungs are far greater than between the different tissues of the stomach, and I may say, indeed, of any other organ. If the mucous coat of the stomach be even severely inflamed, the disease generally remains limited to that tissue, and will far sooner give rise to inflammation of the pulmonary mucous membrane than it will be extended to the cellular, muscular, or serous tissue of the stomach, however much it may otherwise disturb their functions. On the contrary, however, it is quite otherwise with the lungs; especially when the cellular or parenchymatous tissue of these organs is actively inflamed, or when chronic disorganizing inflammation invades the same tissue. In either of the cases, the inflammation is apt to be propagated, sooner or later, both to the serous and mucous tissues of the organ (§ 115–117, 129, 132–155). And

here may be observed a wise ordination of Nature for the ultimate relief of so grave a disease as acute or chronic inflammation of the main substance of the lungs; an augmented secretion of mucus or serum contributing to that result, in connection with a reflected sympathetic influence of the action which is necessary to those increased products (§ 74, 117, 129, 137, 155, 156, 387, 422, 524 *d*, 525). When these redundant secretions take place, the general law is that the primary and secondary inflammations begin to abate. The salutary influence of the secondary disease, independently of the depletive effect, is seen in the frequent abatement of chronic muco-inflammation of the lungs or of the stomach when it may supervene in one organ or the other as a sympathetic consequence of a primary inflammation of either, the philosophy of which is fully expounded in § 905 *a*.

SYMPATHIES OF COMPOUND ORGANS WITH EACH OTHER.

529, *a*. Compound organs generally sympathize most readily with each other in proportion to the relation of certain functions which they may perform, and the importance of those functions, the stomach always excepted (§ 528). These groups or systems of organs have been already specified, and the sympathies to which they respectively give rise among their component parts sufficiently designated (§ 124–130, 149, 150).

529, *b*. Morbid sympathies are influenced by a great variety of accidental causes, although they depend essentially upon the constitutional relations of the various parts of the organism to each other. One of the most remarkable is the determination which is given to reflected nervous actions by almost inappreciable impressions exerted by morbific and remedial agents upon some particular part, according to the nature of their virtues, one agent ultimately involving the whole system in morbid action, or one remedy being as extensively curative (§ 149); while others, far more intense and rapid in their operation, are very circumscribed in their analogous sympathetic effects (§ 149, 150, 163). In the case of the morbific agents where many organs are brought into sympathetic derangement, the various results may be mostly due to the action alone of a single cause, as with the miasmata of fever, the virus of small-pox, of scarlatina, &c.; or, the complex results may be greatly owing to the united action of many causes. In the case of remedial agents, their effect as to extent, intensity, &c., will depend much upon the exact nature of the pathological states.

530. Having now arrived at the end of our long journey over the enchanting paths of sympathy, I cannot but hope that they, to whom the mere physiological explorations may be new, will have gained many treasures that will adorn their knowledge, and render medicine a subject of their profound veneration and care. An attentive survey of all the facts will assure them how far they have lived on in ignorance, how much intellectual enjoyment has been lost, how they have been beguiled into the chemical and physical doctrines of life; and, if what I have propounded of the applicability of the natural laws of reflected actions of the nervous system to pathology and therapeutics be founded in truth, the realities of Nature and the substitutes of art will strike with greater force, and supply a never-failing source of advancing knowledge, a shield against the corruptions of ignorance or ambition, a guide to practical habits, and a blessing to

the sick. The natural laws of the nervous system are settled by demonstration; as well settled as the laws of gravitation, or any of the most undoubted in physics or chemistry. Such as are immediately applicable to the higher and more difficult branches of medicine I have selected from authors who have had no such objects in contemplation, that they might come unalloyed with the suspicions attendant on theory. My attention, in this respect, has been mostly turned to the great Prussian Physiologist, by far the greatest of the age, and to the invaluable experiments by Wilson Philip. I commend them again and again to all those who would study medicine as founded in Nature, and escape the temptations which have been devised for the gratification of indolence, or for the accommodation of imbecility. We have seen it said, in high quarters, that "the time is approaching when the *foundation of practice on the laws of Organic Chemistry* will form the distinction between the enlightened physician and the mere pretender" (§ 5½ *a*, 289–292, 349 *d*–376¾, 438–448). I repeat the declaration as expressing the ascendant spirit of the age, and that all who may be disposed to encounter the threatened degradation may duly realize the importance of a firm determination to maintain their ground (§ 440, *b*).

B. *Functions especially relative to the Mental Principle and Instinct*

531. The present subdivision of Peculiar Functions having no special relations to organic life embraces but transient subjects for consideration in this work (§ 450). It comprehends,

1st. *Voluntary motion.*

2d. *Functions by which the mind and instinct act on external objects*

3d. *Other mental and instinctive functions.*

532. The subject of voluntary motion has been already sufficiently examined (§ 215, 227, 232, 256, 257, 486, 487, 500).

533. The functions by which we act on external objects are performed through volition and the voluntary muscles. The philosophy is the same as in § 532.

534, *a*. The brain co-operates with the mind, and with the instinctive principle, in the acts of intellection or instinctive functions (§ 241, 500 *o*, *p*).

534, *b*. Although the soul be an immaterial and imperishable substance, it is so associated with the brain that a healthy state of this organ is generally necessary to the ordinary functions of the mind, as it is, also, to those of instinct.

In a general sense, the mental functions suffer in proportion to the extent and suddenness of cerebral disease; and the same is true of the influences of the brain upon organic life. There is not always, however, a correspondence between injuries and diseases of the brain and the resulting affections of the mental principle. Apparently slight injuries or diseases of the organ will suspend or abolish the faculties of the mind, while in other cases their integrity is preserved under the most appalling affections of the brain. It is also remarkable in those cases where the mind is least affected or unimpaired, that the organic functions are apt to suffer least.—(*Med. and Phys Comm.*, vol. ii., p. 139, *note.*)

*** Subject continued in *Appendix*, article Soul & Instinct.

VITAL HABIT.

535. VITAL HABIT relates to the modifications of functions, and the variations of their results, in organic and animal life, as arising from the repeated or continued operation of natural, morbific, or remedial agents. It frequently happens, however, that the single application of a vital agent will establish this condition (§ 516 *d*, no. 6; § 545).

This simple principle is at the foundation of some of the most profound and comprehensive laws in medicine (RIGHTS &c., p. 919, no. 19).

536. The functions of organic beings, plants as well as animals, are liable to great and more or less durable changes from the foregoing causes. I have applied the epithet *vital* to distinguish this constitutional law from those ordinary *physical habits* which are almost peculiar to man, and of which *vital habit* is a common result.

537. The functions of animal life, in man especially, are more under the influence of vital habit than the organic. The latter are variously affected, as to habit, by climate, season, food, and morbific and remedial agents, and by disease. The results of habit are most important in its relation to the groups of causes now mentioned.

538. Habit is liable to be more strongly pronounced in plants and animals by certain influences, particularly domestication, climate, and soil, than in man. Thus, as to vegetables, the ricinus communis is an annual herbaceous plant in America, while in India and Spain it is a woody perennial tree. The acquired power of enduring cold is strikingly manifested in man, animals, and plants (§ 442, 1046–1050).

539, *a*. The philosophy of vital habit consists either in a tendency of any given condition of the vital states to remain without change, as a consequence of its duration, or in certain impressions or changes that are produced in irritability, sensibility, and mobility, in their relation to each operating cause, by which their susceptibility to the action of the particular cause or causes is diminished or increased (§ 176–215). The philosophy is alike applicable to the properties of the mind as to those of the vital principle, and, of course, to the functions of each (§ 173–176).

539, *b*. In animal life, therefore, habit concerns the senses, voluntary muscles, and the intellectual and instinctive faculties. In organic life, it refers to the organic properties and functions of every part, whether organic or animal, and takes in the various and important influences of the nervous system (§ 110–117, 224, 226, 495, &c.).

539, *c*. Since, also, the influence of habit in either life generally relates to the particular agents only by which it is induced, we learn the advantages of interchanging cathartics, anodynes, &c. (§ 149, 163, 550). And so of the different modes of exercise, as it concerns both organic and animal life; and so, too, of the employments of the intellectual faculties, that a due improvement may be imparted to each (§ 565, 566, 855, 872 *a*).

540. The principle of habit is every where the same; always relative to impressions, more or less durable, upon the vital or mental constitution. The analogy is perfect throughout, in all its details, and is utterly subversive of every chemical or physical view of life or disease (§ 1047).

541. It illustrates the instability of the vital properties (§ 177–223).

542. The modifications arising from vital habit exercise an important sway in the treatment of disease; since remedial agents must be varied in kind, force, quantity, time of repetition, &c., according to the artificial modifications of irritability and sensibility, especially the former (§ 150, 188–204, 857).

543. Habit is liable to obtain under the repeated or continued operation of almost all agents which are capable of affecting the vital or mental properties. Exceptions occur in sensibility as it respects pain from injuries, and in the ordinary pleasures of sense, which are always about the same, however frequently repeated. But the pain on tasting acrids, the nausea from tobacco, &c., may cease to be produced by repetition of the causes. So, also, of the bougie, music, landscapes, the verdure of spring, &c., which are more or less variable in effect. An interval of suspension, however, in these cases, restores the original effect of the causes.

544. It is by vital habit that morbific agents, such as miasmata, cease to be injurious. This is most likely to happen if the individual reside from infancy in the miasmatic region, or, in the unacclimated, after recovery from an attack of the miasmatic disease. Such is the philosophy of acclimation (§ 539, 551); and the same is alike applicable to tobacco, &c., and to its ultimate conversion into a luxury.

545. Sometimes the single application of a particular agent will so confirm the intensity and permanence of habit that it becomes forever afterward inoperative. Such is not unfrequently the case with miasmata, and it is conspicuously shown in small-pox, measles, scarlatina, &c. And so of vaccination in its relation to small-pox; though repetitions of the vaccine disease may be necessary to even a temporary exemption from small-pox, while at other times the effect goes off, leaving individuals exposed to small-pox (§ 350, no. 45, 543). All this shows, too, a near identity between the vaccine and variolous diseases (§ 75–79, 552 *a*, 654 *b*, NOTE AAA p. 1146).

546. The law of habit applies extensively, also, to remedial agents; these having the effect, by repetition, of lessening or increasing the susceptibility of organs to their respective virtues.

547. Habit, in respect to remedies, as, also, to morbific causes, demonstrates their reflex nervous influences, and that they do not operate by absorption. Introduce the agents with any frequency into the circulation, there will be no such manifestations of the laws of habit.

548, *a*. The effects of habit in organic life are generally most permanent when induced by causes of unceasing and long-continued operation, such as climate, the presence or absence of light, &c. There is then some very persisting or permanent modification of the organic properties, and sometimes very remarkably of the structure (§ 74, 538, 545).

548, *b*. The foregoing law is of very extensive application in the philosophy of disease, and replete with practical bearings. Its illustrations are constantly seen in the obstinacy of chronic diseases, and in the comparative inefficiency of remedies when the treatment of fevers is neglected for a single day.

548½, *a*. In a general sense, the natural vital stimuli, such as food which is of easy digestion, heat, water, &c., for obvious final causes, produce, like the blood, nearly the same impressions upon the organic properties, at every age, and at every hour, under equal circumstances (§ 136, 137).—See CAUSES, FINAL, *Index I.*

548½, *b*. Nevertheless, certain kinds of food, and analogous stimuli, as wine, &c., come within the law of habit. This is where the kind of food may not be natural to the age of the individual (§ 568); or when it may be at first oppressive or detrimental at any age, it may become, by use, inoffensive and nutritious. During the first experiments the food may escape the stomach undigested, having, also, irritated that organ, induced headache, &c. But, in a process of time, the irritability of the stomach becomes adapted, by habit, to the presence of that particular kind of food, its ready digestion follows, and all sympathetic results disappear. It is exactly the same law that renders tobacco, asafœtida, &c., luxuries (§ 543).

549. The law of habit, in respect to morbific and remedial agents, follows the law which governs the relative duration of disease when produced by remedial agents and such as are truly morbific. Disease excited by the former, if not in great intensity, soon subsides spontaneously; but when by the latter, it is far more lasting. This principle, also, as it relates to remedial agents, is at the foundation of their curative effects (§ 893, &c., 926).

550. Since habit subsides in various degrees, and at various times, after the removal of its causes, and the properties of life acquire, therefore, more or less, their original susceptibility to the particular agents or causes (§ 539, 543), and since the effects of remedial agents are commonly transient in respect to habit (§ 549), we may, in most cases, soon resume the suspended remedy, and obtain its original effect (§ 539 *c*, 857). And just so of acclimation; its influences ceasing on change of residence, when miasms will be again morbific on returning to the former acclimated region. And so of pleasure and pain (§ 543). The coincidences demonstrate the fallacy of humoralism (§ 665).

551. Again, it is through the principle of vital habit that we must interpret the ability of the system to sustain, with the same or diminished effect, increased doses of remedial agents, as opium, tartarized antimony, &c., while this peculiarity will be limited to the agents which are thus employed. The eighth of a grain of tartarized antimony may produce vomiting at the first dose; but, by gradually increased doses every two hours, it may be sometimes raised in twelve hours, by lessening gastric irritability in relation to its own virtues, to two grains at a dose, without vomiting again (§ 556). But gastric irritability will not be thus reduced in relation to any other emetic. And so of miasmata, &c.; and I may add to § 544, that if the unacclimated pass gradually through a series of climates having gradations of miasmatic intensity, he will ultimately reach its highest virulence with far greater safety than if he plunged at once into its fury. Should, however, epidemic influences occur of an unusual nature, he will still be as much, or more exposed to their malign effects than in uninfected countries (§ 150).

552, *a*. Other parallels hold, also, in the foregoing cases (§ 551). If, for example, the antimony be suspended for twelve hours, gastric irritability will recover its natural relation to that substance, &c. And so of the miasmatic agent, if the acclimated subject retire to a salubrious region, and subsequently revisit the insalubrious (§ 557, *b*).

552, *b*. Again, the antimony impresses the system in the ratio of its action upon the stomach, or of the duration of its action. Fever, or pneumonia, &c., will fail to be assuaged unless the gastric effect be

kept up, if the agent be employed in its small alterative doses. Or a single dose, operating as an emetic, may at once overthrow the disease (§ 524 *a*, no. 1). And so of miasmata; since, in the case supposed (§ 551), the individual may be gradually brought under its influence, till, at last, its greatest intensity may produce an explosion of disease; or, this may ensue with great rapidity in the same subject if the gradual acclimation be neglected (§ 514 *g*, 516 *c*, 518 *b*, 557 *b*).

553. No two agents being precisely alike in their effects, habit will vary according to the exact nature of its causes (§ 150, 191, 649). Some, like antimony, often lessen irritability with great rapidity, and the property will recover its relation to the agent after a short interval of suspension. Others as frequently require a much longer time, and irritability will take various intervals of repose, often months or years, to recover its relation to these agents.

554. It is fundamental in medicine that the foregoing intervals (§ 553) are not long as it respects remedial agents, in their ordinary use, but much longer in respect to the truly morbific causes. In the case, for instance, of acclimation (§ 551), if the subject return to a salubrious climate, it may be many months, or years, before the system will have recovered its susceptibility to the miasmatic agent.

555. The foregoing exemplification of habit in respect to morbific and remedial agents (§ 554) is allied to the principle which lies at the foundation of disease, and of its cure by remedies, whether physical or mental. Disease consists, essentially, in a more or less permanent alteration of the organic properties; while remedial agents establish more transient alterations, which enables the morbid properties and actions to obey their natural tendency to a state of health.

556, *a*. Vital habit appears, also, under an aspect opposite to that of diminished irritability. It then presents itself more in the condition of a morbid change of the organic conditions. Thus, tartarized antimony, instead of reducing gastric irritability, as in § 551, may exalt it; so that, beginning with the eighth of a grain, as in the former example, but without an emetic effect, and repeating it without even increasing the dose, vomiting will take place at the second or third dose (§ 514 *g*, 516 *c* and *d*, no. 6). In these cases, we must sometimes progressively reduce the dose to the fiftieth part of a grain, or vomiting will ensue. In this particular case irritability is also increased in its relation to ipecacuanha, and to most other irritants (§ 841).

556, *b*. This lets us into the philosophy of the most successful mode of overcoming habitual and obstinate constipation, by small doses of cathartic medicine, repeated once or twice daily; as the fourth of a grain of blue pill, and half a grain or a grain of aloes. The irritability of the intestine is thus permanently exalted, by which it is soon rendered so sensitive to the increased quantity of bile as to require a diminution or discontinuance of the medicine. The impression of each dose remains till the next is repeated (§ 514 *g*, 516 *c*, 516 *d*, no. 6). The law of increased susceptibility is brought into operation § 137, *d*, and alterative reflex action increases the bile (§ 889 *l*, *m*).

What I have thus stated in this section involves some of the most important philosophy in medicine. In its practical nature it takes in a wide range of therapeutical problems, some of the most essential of which are relative to the dose or the amount of a remedy, and the proper time for its repetition (§ 857).

556, *c*. The foregoing principle is farther shown by the effect of saline and other cathartics in promoting salivation when given a few hours after the exhibition of a full dose of calomel. The fact was ascertained by George Fordyce, and has been often verified in my own person after the use of blue pill. The mercurial agent will not exert, in the cases supposed, this profound constitutional effect without the subsequent aid of the other agents, which so increase intestinal irritability, and that of the whole system, that the mercury operates with greater local and general intensity; a fact, by-the-way, which is also opposed to the doctrine of operation by absorption. Just so, too, bloodletting increases the susceptibility of the system to the constitutional and local action of mercury, cathartics, and many other agents, while it also lessens much their doses. A common principle lies at the foundation of the whole (§ 150, 890½ *g*, 892½ *u*, 893 *q*, 904 *c*, 1088).

556, *d*. Augmented irritability, sensibility, and mobility, in their proper relation to habit, depend often upon peculiar states of the stomach, on constitution, climate, &c. Hence in some climates certain remedies, as antimony, are borne much better than in others; cathartics often exalt irritability (especially of the direct seat of action) in an intense degree, &c.

But other influences in connection with the foregoing are often in operation, and may be the main cause of the effects which are, at other times, due to the causes now supposed. Thus, cathartics are liable to be surrounded by such influences, especially by increased irritability from the presence of disease, or as the effect of passion, or the play of sympathy, or the bile may be increased in quantity or in its stimulating virtues. These modifying influences may be variously applied.

557, *a*. The difference in the results of the same remedy in analogous conditions of disease often depends upon, and illustrates, the law of habit. Thus, an emetic and cathartic, exhibited near the invasion of *continued* fever, will often break up the disease; but not so if the fever have been neglected for twenty-four hours. The morbid action is then under the power of habit. On the contrary, an emetic will often remove an *intermittent* fever of long duration if administered during the intermission. Here, the febrile action being greatly suspended at regular intervals, the force of habit is constantly broken, and nature puts on its recuperative tendency (§ 555, &c., 715, 926).

557, *b*. A special exception occurs, however, in the abstraction of blood as it regards its remedial effects upon disease which has acquired the force of habit. In active or chronic forms of inflammation, and in fevers of considerable duration, general bloodletting, particularly, when carried to its just extent, may at once subvert the disease, or, at least, greatly cripple its force and its habitual tendency. Here, an impression is simultaneously and powerfully made upon the whole circulatory system, and that which is thus exerted upon the immediate instruments of disease is greatly advanced by reflex nervous actions from all parts of the capillary blood-vessels (§ 921, 931–934). There is, therefore, a clear analogy in *a* and *b* with the modus operandi of miasmata when they prove the exciting as well as predisposing cause of disease near the first moment of their contact with the body (§ 552, *b*)—philosophically considered (§ 654 *a*).

558, *a*. The principle involved in § 556 embraces what is called the

cumulative effect of remedies, and of which digitalis, hydrocyanic acid, mercury, narcotics, &c., supply examples, in their small repeated doses (§ 514, *g*). And yet some of the same agents, as the narcotics, by longer use, will establish the opposite condition of habit, or that of diminished effect; thus illustrating the different aspects of the laws of vital habit.

558, *b*. In the cumulative aspect of habit, the agent, as digitalis, or mercury, or cantharides, for instance, establishes progressive impressions on the vital states, proportioned to the amount and frequency of the dose, *cæteris paribus* (§ 926). When that impression reaches a certain degree of intensity, the organic properties are brought into so full a relation with the morbific virtues of the agent, that they undergo, abruptly, a greater change; when the phenomena of full mercurial action, of digitalis, &c., take place suddenly, and perhaps with violence. The last is morbid, and exactly the same as we have seen of the progressive operation of miasmata (§ 552, *b*). But we often see manifested by digitalis, prussic acid, &c., the same variety of habit as was stated of tartarized antimony in § 551, since we must often increase the dose to maintain the original effect. And so, again, of miasmata (§ 551). This, however, is not true of some of the cumulative remedies, such as the mercurial (§ 516, *d*, no. 6).

558, *c*. And now, to illustrate the alterative reflex action of remedial agents by the process of removing the morbid effects of the foregoing cumulative remedies (*b*), we have but to interrogate the only possible manner in which we may speedily subdue those effects by other remedies, and as explained in § 891½ *k*, 984 *b*.

559. Exactly the same philosophy (§ 558) is applicable to what is called predisposition to disease (§ 148, 503, 538, 539, 544, 547, 552 *b*). Nevertheless, predisposition may differ from the cumulative impression of remedies in being established by a single, and even momentary action of the morbific agent, when the organic states may go on with their morbid tendency till an explosion follows, as in § 148, 653. So, often, of a single dose of mercury in respect to its curative effects (§ 514, *g*). But, the difference lies in the greater intensity of the agent, or in a greater susceptibility of the subject to its action, or in both (§ 549, 666, 516 *d*, no. 6).

560. Another aspect of habit, as it respects morbific agents, and which goes with the rest to illustrate important principles in medicine, is the tenacity of many diseases, as shown in periodical returns of intermittent fever, at intervals of months, even after the subject shall have removed to a climate exempt from the causes. Here the original impression remains (§ 514, *g*), and frequently, also, some local form of disease, by which the general predisposition is maintained, and its explosions more or less produced (§ 148).

561. What concerns the acquired habits that appertain more or less to the constitution of all men, and which have a modifying, and often a great, influence in determining the operation of morbific and remedial agents, comes entirely within the foregoing principles relative to vital habit; and this is more obviously true of the accidental modifications of temperament that arise in individuals from the influence of climate, heat, cold, &c. (§ 78, 442 *b*, *c*, 535, 539). Where the peculiarity of constitution is transmitted from parent to child the modifying causes have, of course, operated upon the ancestor. But the

transmitted peculiarity is equivalent to that which is generated by the direct action of the modifying agent (§ 75–80, 585, 587, 591, 659).

Here, too, we may observe how the incubation of fever, for a week or for months, is analogous to the slow progress of the artificial temperaments; though, in the former case the remote causes may operate for an hour only, and thus establish a tendency in the organic properties to advance in their morbid predisposition, till, reaching a certain amount of change, a development of fever is suddenly displayed; while, in the artificial temperaments the changes are commonly the result of the continued operation of the remote cause.

562. The luxuries and customs of civilized man affect his natural constitution upon the same principles as morbific agents produce disease, or as the remedial alter the properties of life back again to a state of health. In all the cases, the results are owing to impressions variously made upon the properties of life (§ 191 *b*, 535, 539).

563. So simple is Nature in her elementary laws that the periodical desire of food, and many little usages of the body, fall, more or less, under the comprehensive law which I have exemplified by prominent instances of habit. And here, too, we glance at the philosophy of instinct in its magnificent relations to certain natural habits; and realize, also, in the phenomena, the principles which are concerned in the analogous relations of the will to voluntary motion (§ 500, *c–h*).

564. In my last proposition I was on the borders of *education*, which is mostly confined to animal life, or extended to both where animal and organic are associated in functions.

Education is allied to habit in its philosophy, as manifested both in the cultivation of muscular power and the properties of the mind (§ 175 *b*, 241).

565, *a*. Education often improves some of the animal functions at the expense of others; but this mostly where some are more the subjects of cultivation than others, as seeing, hearing, &c., or the muscular action of the arms, &c. (§ 539, *c*). When one sense, as sight, is extinct, others, as hearing and touch, become very exquisite. In the case of the muscles, mobility is augmented, and their nutrition increased; in that of the senses, sensibility.

565, *b*. A more critical analysis, in the case of the muscles, shows us that mobility in organic, and its modification in animal life, are both advanced (§ 205, 215). Hence result the increase of voluntary power and the increased size of the muscles. By this muscular exercise the function of digestion is also increased, the elaboration of bile, and important vigor is imparted to the whole organic mechanism. The principle is exactly the same as in all the preceding examples relative to vital habit.

566, *a*. This chain of exact analogies brings us to the properties of the mind, which are improved upon the same principle (§ 175 *b*, 241, 565). Here, as in the foregoing instances (§ 565), one or more of the properties is apt to be exalted at the expense of the rest (§ 539, *c*). The poet, therefore, thinks differently from the man of cultivated judgment; the lawyer is prone to sophistry and skepticism; the mathematician is wrapped in abstract truths, and deficient in practical business; the clergyman, from his well-disciplined trust in Revelation, and his scholastic habits, suffers that trust to degenerate into credulity, and too

often patronizes homœopathy, or delights in animal magnetism, or even in the anti-scriptural speculations of the geologists. The history of nature is nothing to the chemist out of his laboratory; in physiology he is like the astrologer among the stars. Shall I speak of the physician? It is said by Samuel Johnson that he is more apt to cultivate all the powers of his understanding, and all departments of nature, together, and that he has therefore been more distinguished for an enlightened and comprehensive view of the various subjects for reason than any other class of mankind.

566, *b*. And now we are prepared to comprehend the analogies between those impressions which are brought about by the habitual action of external objects upon the senses, and in which the mind is concerned, as in the satiety of spring, the increasing enjoyment of painting, sculpture, and music, and the increasing acumen with which their beauties and refinements are discerned, and, also, those other changes that are incident to the organic properties from the habitual use of tobacco, of stimulants to the nose, to the stomach, &c., or such as arise from tartarized antimony, acclimation, and those moral influences through which the black skin, the low forehead, and the flat nose, are rendered more beautiful to the African than the analogous features of the white man, or which render the flattened head, and the scarified face, an ornament to the eye of the American Indian, or the deformities of the corset, or the artificial rump, elegances in polished society, while the few that worship at the Graces' shrine become objects of dislike. The same fundamental philosophy obtains throughout.

567. From the foregoing analogies between the mental and vital powers (§ 566), it appears that the former are cultivated through the medium of the senses and brain, and as well by external influences as by the operation of the sensorium commune, upon the same principle that the vital properties are influenced, more or less permanently, by the operation of foreign agents (§ 175 *b*, 241). The impressions in respect to mind, however, are more complex, since, in this case, they come to the spiritual part through material organs.

568. We may now see the nature of the analogies between the special injuries which result from too much or improper food in the early stages of life, and crowding the mind with study or with topics beyond its easy comprehension; and those between the ultimate adaptation of the properties of the stomach to what was once offensive, and the corresponding development of the properties of the mind and of its organs by which it sustains what had been detrimental to both, and to the general health. These principles lie deeply at the foundation of a proper elementary education of the mind (175 *b*, 548½ *b*, 567).

STRENGTH, AND WEAKNESS OR DEBILITY.

569, *a*. Much of what has been now considered under the various aspects of habit is often vaguely defined by the terms *strength*, and *weakness* or *debility*. The terms are without any true meaning, and have led to very extensive practical errors. If the finger become inflamed, muscular action is impaired in the hand, or arm. This is called *weakness*, *debility*, both of the vessels which are engaged in the morbid process, and of the muscles. But, bloodletting, either general or by leeches, will cure the disease and restore muscular action.

Here the nature of the remedy contradicts the supposed philosophy (§ 743, 801, 964).

569, *b*. *Strength* and *debility* are, also, often confounded, leading to still greater confusion and error. Thus, manifestations of full muscular power are said to denote strength, while the high vascular action of inflammation is supposed to depend on debility. The former is also often seen in deplorable states of disease where debility is thought to reign supreme. On the contrary, also, the mere prostration of voluntary motion at the very invasion of disease is as constantly considered a state of debility, however exalted may be inflammatory or febrile affections upon which that contingency in animal life may depend. Tonics and stimulants, therefore, have their sway according to these supposed imaginary conditions,—imaginary, since disease consists neither in one nor the other, so far as they have any intelligible import. The designations, for the most part, are borrowed from the inorganic world; and even at this day some physiologists are making experiments upon the dead muscular tissue by immersing it in solutions of tonics and astringents, to learn the value, and the modus operandi, of those agents when applied to morbid states of the living being. Dr. Adair Crawford, for example, in his *Experimental Inquiry into the Effects of Tonics and Astringents* (1816), attributes their influence entirely to the tanning process, by which physical cohesion is established. His premises are those upon which the illustrious and able Pringle, and his compeers, rested the same conclusion; animal membranes having been immersed in various infusions, and comparisons made of their resistance to weight with the same membranes soaked in water. *Strength* was implied in the former instance (§ 487 *h*, 1001–1008, 1019, 1068).—Notes Ff p. 1135, Ii p. 1139.

569, *c*. If strength and weakness, or debility, be applied to organic states, it must be in a totally different acceptation from their ordinary meaning. In their vital applications, they can relate alone to any present condition of the vital powers. In this sense, the greatest strength of the body consists in a natural performance, by all the organs respectively, of the functions appropriate to each, without either borrowing from the others any assistance which it does not constitutionally enjoy, and without taking upon itself any undue amount of labor. In a state of undisturbed health, and temperate habits, the functions of all organs move on in harmony, each administering to the others a certain allotted contribution. But, in impaired constitutions, the whole of this natural harmony is more or less disturbed. Digestion is imperfectly performed, and every meal tasks the stomach beyond its natural ability. The other organs suffer, sympathetically, in consequence, and often seem to bend their actions toward a co-operative effort in aid of the diseased actions of the stomach. In this sense, therefore, all the powers of the system may be said to be unnaturally tasked. But, in the mean time, all the sympathizing organs are themselves afflicted, and just in proportion as they sympathize with the stomach. The food escapes from this organ in a half-digested state, in which chemical changes have also occurred. These changes beget acids and flatulence, and, as the crude mass traverses the intestines, it irritates, and increases the sympathetic derangement of those organs, while these, again, reflect back pernicious influences upon the stomach and all other parts. Increased and unnatural mucus, diar-

rhœa, &c., follow in the train of intestinal symptoms, urged on by an unhealthy production of bile; while an offensive taste in the mouth, a foul breath, or a coated tongue, tell us of the sympathies which are going on in that region. The red or turbid urine shows us that the kidneys have joined in the disordered actions. The pulse may be languid, or it may beat high, according as inflammation may be absent, or have set in as one of the sequelæ; but according to the accidental state of this symptom *the degree of weakness* is greatly measured in this complex and very common condition of disease (§ 423). But, whatever the symptoms, the system is said to be *weak*, to be *debilitated*. There is, however, no truth in this construction, as it is ordinarily understood. The powers may be all exalted; and that this is generally so, is shown by the increased secretions from the liver and intestines; while it is fully demonstrated by the nature of the curative means, which consist especially of a low diet. The supposed debility is nothing but an altered condition of the properties and functions of life, and the very remedies which the idea of debility would suggest, such as stimulants and tonics, are generally aggravating causes. Such is the exaltation of irritability, especially in the intestinal canal, that it may not bear even the stimulus of broth, nor the mechanical irritation of solid food.

569, *d*. The nearest approach to the popular sense in which debility is properly applied consists in the exhaustion of the organic powers that attends the advanced stages of prolonged disease.—See § 487 *h*.

So far, therefore, as *debility* has an existence, and as connected with disease, it is nothing but a *symptom* resulting from some modified condition of the functions of one or more organs, in which the true pathological cause consists, and to which alone our remedial treatment should be addressed. The humoral terms *anæmia*, *leucæmia*, *cachexia*, and *chlorosis*, in their connection with *iron* and debility, are, therefore, responsible for an incalculable amount of mortality. But as I have said, much of this *symptom* (always mostly so in the early stages of disease) is owing to the failure of the Will to act upon the voluntary muscles (§ 487 *h*, 961); and when this circumstance is duly considered it may result in a profitable inquiry into the probable extent of mortality that may be ascribed to the tonic and stimulant treatment of disease (§ 621 *a*, 1001 *a*, 1065 *c*, 1068 *a*). No writer who has discarded loss of blood as a principal remedy for inflammations and congestions, or inculcated "the stimulating plan," has survived his own generation excepting John Brown, and his work exists only as a curiosity in medical literature (§ 1068 *a*). The practice is perpetuated by individual prejudices and impulses (§ 960 *g*), not by the authority of enlightened or recognized experience, nor by any thing in the pathology of disease (p. 872).

569, *e*. Finally, I may conclude this subject with the nervous language of Southwood Smith (*On Fever*): Thus—even "in the intense forms of congestive fever, I look upon the notion of debility to be an error not less palpable in its nature, than destructive in its consequences; and if the havoc it produces do not confer upon it a pre-eminence as bad as that of the very disease of which it is supposed to constitute the essence, it at least entitles it, in comparison with every other error in medicine, to the distinction recognized in society between the hero and the murderer. The one destroys a single human being now and then, but the other numbers its victims by thousands."

FIFTH DIVISION OF PHYSIOLOGY.

MODIFICATIONS OF THE VITAL PROPERTIES AND FUNCTIONS ARISING FROM AGE, TEMPERAMENT, CONSTITUTION, SEX, VOLUNTARY HABITS, &c.

570. The differences among individuals, and classes of mankind, which arise from age, sex, temperament, &c., may be regarded in the light of qualifications of the four preceding grand attributes of organic beings.

571. Organic beings are liable not only to permanent changes in their constitution from external influences, but to others of an inherent nature. Constitution and temperament supply examples of the former; age and sex of the latter.

572. These changes (§ 571) consist in varying conditions of the properties of life, and possess, therefore, not only important relations to the physical agents of life, but modify, according to their different circumstances, the operation of morbific causes, and our therapeutical treatment.

573. All the foregoing conditions spring from the natural instability of the vital properties; and such as are brought about by external influences involve exactly the same philosophy that is concerned in vital habit (§ 177, 539). Under the present division of Physiology, however, the modified conditions are, in a general sense, of a far more permanent nature than such as I have assigned to vital habit.

I. AGE.

574. As our bodies undergo progressive changes from the time of birth to the end of life, the duration of human existence has been divided into five periods; namely, 1st. Infancy; 2d. Childhood; 3d. Youth; 4th. Adult or middle age; 5th. Old age. They mark the times during which the greatest physiological changes take place.

575. The differences which grow out of age consist in variations of the external form, and of the forms and density of the internal parts, of variations of structure, and of natural modifications of the vital properties and functions. Upon these last depend all the other changes (§ 153–155, 237).

1. INFANCY.

576, *a*. Infancy extends from the time of birth to the end of the first dentition.

576, *b*. At this age the fluids predominate. The organs are now softest. The bones are imperfectly ossified. The muscles small. The arteries are as numerous as in the adult, but more capacious. The cutaneous veins small, while those of the brain, and some other internal organs, are well developed. The skin warm, thin, and delicate, covered with soft hairs and underlaid with fat, which, in the adult, is removed to the internal viscera; acute in irritability, obtuse in sensibility. The eyes are large, but inobservant, resting, for the most part, on dazzling objects. The organ of hearing is imperfect and dull, and attracted only by acute or loud noises. The nose small

and irritable, sensitive in the nasal branch, but dull in the olfactory. Taste indiscriminate. Sensibility and irritability are highly developed in the intestinal canal. The teeth are making their way, one after another, till at the end of two and a half years, the first dentition is completed. Digestion and nutrition are in rapid progress, and the secretions and excretions copious. The appetite great, and returns almost as soon as appeased. The development of the digestive system keeps pace with the progress of the teeth, and when eight or ten shall have appeared, the stomach is ready for a gradual change of nutriment. The limbs are feebly controlled. Sleep is often repeated and long continued, being scarcely interrupted for the first week, even by hunger, so powerfully is the new being under the influence of its fœtal habits. Few mental impressions being made there is no trouble from dreams. Sleep is therefore calm while the organs maintain their healthy round. It is all sleep or all wakefulness, with but little of the revery of later years. The pleasures are sensual and without alloy, but very limited. The gratification of appetite is the highest enjoyment, and hunger the greatest suffering. Judgment and reflection are in a dormant state. The mind is easily irritated, but as easily appeased; and crying is as natural and salutary as laughing at a later age.

576, *c*. The most important peculiarities of infancy, physiologically, pathologically, and therapeutically considered, are the general imperfect development of sensibility, and the greater general development of irritability, mobility, and sympathy, than at any other period of life.

576, *d*. As the diseases of infancy, like other ages, correspond with the physiological characteristics (§ 155, 156), they are not liable to be aggravated by causes which operate through common and specific sensibility; but the greater development of irritability, especially of the brain and intestinal canal, than at any other period of life, subjects the infant to a predominance of cerebral and intestinal diseases. It is owing, also, to this physiological condition of the alimentary canal that any excess of food is readily rejected by the stomach. But irritability, in being thus susceptible of the influences of the natural vital stimuli, that all its contingent purposes may be fulfilled, is especially liable to morbific impressions (§ 137 *d*, 150). It is owing to the imperfect development of the cutaneous veins in infancy, and childhood, that there is an absence of varix; and, on the other hand, cerebral congestion and hydrocephalus are now common, because the cerebral veins, and the brain itself, are large and highly endowed with irritability. Croup also prevails, and is more or less attended with a production of coagulable lymph, because of a peculiar natural modification of the organic properties of the mucous tissue of the larynx, which changing at later periods gives rise to catarrhal inflammation (§ 134, 135). Morbid sympathies are common and strongly pronounced, especially between the intestinal canal and the skin, and between the former and the brain. The sympathies, however, are mostly on the side of the skin and the brain, the primary affections being in the intestinal canal. Next, the lungs are liable to pneumonia, but most so after dentition begins. The appearance of the teeth is attended with some new physiological conditions, and dentition aggravates or gives rise to intestinal derangements, disturbs the natural sympathies of organs, and provokes convulsions of the voluntary muscles (§ 526, *d*).

576 *e*. Diseases being rapid and active in infancy, and injurious sympathies speedily and powerfully determined, it is obvious that remedies must be prompt, decisive, and of quick operation. But, it is also an important consideration that nature is now strongly recuperative; that the same physiological susceptibilities of infants to disease, and to its rapid advances, render them also peculiarly sensible to remedial agents, when timely and happily applied; and that they now operate speedily and with power on account of the great development of irritability, mobility, and sympathy (§ 150). Hence it is, that milder means which fail at adult age may succeed under apparently the same circumstances in infancy. An emetic, therefore, or cathartic, or alterative doses of tartarized antimony, &c., may become a substitute for a certain quantity of blood, whose abstraction in the same condition of disease would be indispensable at adult age; or leeching may be sufficient in the former case, when general bloodletting would be necessary in the latter. But, since the dangers of disease are greater, and there is less time for delay, in the diseases of infants than of adults, we should be sure of the right before we decide on neglecting or procrastinating the more vigorous treatment. This observation, however, is intended to apply especially to the abstraction of blood. Active internal remedies should be delayed in cases of doubt. On the other hand, an early loss of blood is far less likely to be detrimental; and where it may be required, but delayed, the chance of its useful application may be lost, not only through the advances of disease, but by the prostrating effects of other remedies (§ 155, 156, 925 *a*, *b*, *c*, 964 *d*, 974 *c*, 1058 *p*).

576, *f*. It may be finally said of the characteristics of infancy, that the first few weeks of independent life are marked by peculiarities which go to illustrate the philosophy of life as expounded in these Institutes. Sleep, for example, is remarkably continued; cutaneous sensibility so dormant that injuries of the surface are scarcely felt, &c. But it is in organic life that we meet with functions that are destined for speedy modifications, of which the generation of heat is the most remarkable (§ 441, *b*).

2. CHILDHOOD.

577, *a*. CHILDHOOD extends from the age of two and a half to fifteen or seventeen years in males, and to fourteen or sixteen in females.

577, *b*. Irritability, and the other organic properties, become modified, and variously, in different parts. Those of the brain settle down into that modification which is only necessary to established functions (§ 156); or, at most, do but undergo slighter changes at the subsequent periods of life. Consequently, the brain sheds a new influence over other organs; and irritability, being less strongly pronounced in all other parts than in infancy, they are less disposed to sympathize with diseases of the brain, and of each other, or the brain with them. The digestive system has undergone manifest changes; and here, too, irritability is particularly diminished. Solid food has become indispensable, while it was inadmissible in early infancy; is less frequently desired, and can be digested only when taken at longer intervals. The secretions and excretions have lessened, as a consequence of the changes in the organic states.

Sensibility, especially specific, had made advances in infancy, and increases rapidly in childhood. The various organs of sense are turned with increasing attention to surrounding objects. This denotes an increase of perception and with it the other mental faculties hold a progressive but more tardy pace. As knowledge pours in, the faculties of the mind increase in an increasing ratio. The organs of speech are unfolded, and there is great volubility of tongue The skin has become less delicate, and the sub-cutaneous fat has undergone diminution (§ 440 *bb*, 440 *c*, no. $11\frac{1}{2}$, 441 *c*). The chin loses its double character, and the general features acquire a contour in which that of infancy is nearly lost. They reflect the operations of the mind, and beam with enjoyment when not disturbed by the angry passions that now spring up along with knowledge and reason.

577, *c*. The foregoing new state of things gives rise to new diseases, or to new modifications of infantile diseases. Morbific causes operate according to the new modifications of the vital properties. There are new and modified circles of sympathy (§ 156, 566). New parts become the seat of disease, as the ligaments, the mesenteric glands, the lymphatic glands, the joints. Disease, too, is now apt to result in disorganization, from which infancy is greatly exempt. We have seen that some diseases become less frequent, as those of the brain. The diminution of intestinal irritability lessens the frequency and force of abdominal derangements; and this relative exemption cuts off that exuberance of sympathies which was displayed in the intestinal irritations of infancy. Croup disappears at the age of twelve. Among the new causes of disease may be reckoned the passions, and the new avenues of external influences through the senses; though the absence of grief and the predominance of hope are favorable to childhood. This is the age when severe mental labor does its worst with the constitution.

577, *d*. Remedial agents bear a general relative correspondence with the new physiological conditions, like the morbific, as we have seen of infancy, varied, however, from the latter by the modifications induced by disease (§ 149, 150).

3. YOUTH.

578, *a*. YOUTH extends from the end of childhood to the age of twenty or twenty-five years.

578, *b*. As the characteristics of infancy pass by imperceptible degrees into those of childhood, so do those of the latter gradually fade into the condition of puberty. New phenomena are alike presented by the mind and body; all springing from natural modifications of the same powers which conducted the development of the ovum through all its stages to that of the infant; which carried along the exact vicissitudes of infant life to that of childhood, and which transform the child into a being capable of procreating his species. The developments of structure go hand in hand with those of the vital powers, the latter always taking the lead, according to the ordination of the Creator; and for Whose direct Agency, as exerted at the beginning of organic life, these formative powers are designed as a subordinate substitute,—always fashioning the new being according to the original model (§ 63, 64, 155).

The most remarkable peculiarity by which youth is introduced is

the development of the organs of generation, which, as in plants, may be regarded, in a physiological sense, as the great final object of the development of all the other organs from the embryo state; new beings being thus produced that other new ones may follow. Such, then, being the ultimate tendency of all the physical and vital developments, it obviously follows that a new condition has taken place in all the animal and organic powers at the age of puberty, and that the development of the generative organs will, in their turn, so modify the conditions of life as to carry out the design of nature in perpetuating the species.

578, *c.* Specific sensibility is now at its acme of development, and its corresponding mental power, perception, is in full and rapid operation. Knowledge of external things pours in as rapidly as the eye can glance from object to object, or the ear distinguish the tones of music as they run into each other. The mind now seizes this knowledge, and appropriates it more extensively than before to the improvement of its own powers. It compares phenomena with each other, observes their resemblances and contrasts, and as the judgment, under this exercise of reflection, acquires maturity, it deduces the great laws by which the phenomena are regulated, and finally carries them up to the very powers from which they emanate. But it does not so clearly follow that the provision which nature has made for the right government of the mind or the body will be duly employed. No sooner, indeed, are we born, than abuses begin,—if not on the part of infancy, on that, at least, of its natural guides and protectors. The stomach is crowded with solid food instead of its natural fluid, or when solids become appropriate the least appropriate are often selected. The properties of life being thus abused, they suffer, and not unfrequently perish in consequence. The passions, yea, even anger, are designed for our happiness or for our protection. But judgment is permitted to fail of its legitimate sway, and the passions are let loose to fill us with disease, to imbitter our corporeal and intellectual existences, to incarcerate our bodies, or to hang us upon the gallows.

Coming to the abstract operations of mind, do we not find a like abuse of the understanding? Do we not constantly find that the knowledge which has been acquired is perverted to the worst conclusions? Are not the phenomena of nature which are opposed to each other made to assume resemblances, and such as are clearly allied equally estranged? And do we not then, by this abuse of reason, proceed to refer these incongruous results to common laws and common causes? We need not go beyond the subjects before us for an affirmative answer. Are not all the unique phenomena of life, all those which mark the distinctions between infancy, childhood, and youth, all those which attend the consummation of the body for the development of the generative organs, for the production of the ovum, of the seminal fluid, even sexual desire itself, and its ultimate termination in new beings, ay, the very thoughts which go up to Heaven, most extensively referred, at this thinking, speculative age, to the forces which rule over dead, inorganic matter?* But there is a stage of human existence, which that modified materialism that acknowledges a soul has not yet dared to invade. That stage begins when both parents infuse themselves into their future offspring, when a new soul, like a new body, is generated; and it extends throughout the fœtal development. The same processes, as we have seen, are now in prog-

* See my work on the SOUL AND INSTINCTIVE PRINCIPLE, edition 1870.

ress as at every subsequent stage of life. The same powers, therefore, and no others, are alike at all times the causes of the coincident results (§ 65–76).

Returning to the characteristics of youth, we find that the testes now enlarge, and secrete the seminal fluid; the uterus becomes rapidly unfolded in its powers and structure; the menses take place; and, in both sexes, the arrangements for generation are established. While these peculiar changes are in progress, sensibility and irritability are acutely susceptible, and give rise to restlessness, impatience, and often to anxiety and distress, without absolute disease. The mammæ also prepare for the work of nutrition, swell out, and assume that peculiar rotundity which is considered the beau ideal of beauty. The beard puts forth. The face swells with blood, that the features may be supplied abundantly with the material which is necessary for their full development; and it is now that physiognomy begins to take its rank among the sciences. The muscles obtain greater firmness, greater power, and greater action. The cutaneous veins enlarge beyond their former capacity. The organs of speech undergo another change, as denoted by the hoarse and rough voice. The body spreads, becomes firm and erect, and often shoots up, in early youth, with amazing rapidity.

So much elaboration of structure, and the institution of the generative functions, cannot fail, according to our doctrine of life, as sources of many new reflex nervous actions, of new diseases, or modifications of former disease. The principle, indeed, is fundamental, that diseases vary according to the natural variations that may spring up in the vital states of different parts, or of the entire body, at different periods of our existence (§ 150, &c.). These fluctuations of the natural states of the system, as also disease itself, and its very cure, as we have seen, grow out of the natural instability of the properties of life (§ 177). The natural instability, or liability to definite changes at the progressive stages of life, is ordained not only for the new physical developments that are taking place, but also for certain incidental conditions, such as gestation, lactation, &c. (§ 155, 156). Will chemistry explain?

We consequently find that the concerted action of organs is liable to be disturbed at the beginning of youth, independently of disease. The heart beats irregularly, respiration is hurried, or slow, or laborious, and fluctuates as the passions rise or fall, or as the mind may happen to poise; and the heart, and the cutaneous vessels of the face, obey the same influences. These susceptibilities may be more or less extended to all other parts, without the intervention of disease. Among these physiological results are frequent bleedings of the nose, headache, constipation, and partial disturbances of digestion. So, also, is that pain and distress which attend menstruation, and all the reflex nervous influences which are inflicted upon the system at large during the progress of this excretion. It is the vital, not the chemical powers, which are thus disturbed, but not morbidly affected (§ 237).

578, *d*. Where, however, nature introduces so much novelty there must be new diseases, and new sympathetic results of a morbid character. And now mark the coincidence between the progressive development of the vital states and their liability to morbid affections. The uterus, for instance, has hitherto been merely in a vegetative

state. It has had no specific function, and its organic properties have existed only in that condition which is essential to nutrition. This organ, therefore, has been scarcely liable to any disturbance, not even of a sympathetic nature; for the organ, hitherto, has taken no part in the general operations of the body. And how clearly this illustrates the laws of reflex nervous action in their application to disease, and exposes the absurdities of the humoral pathology! But, as puberty arrives the uterus takes on its specific function; and, that this may be performed there must be a great modification of the organic life of this organ. Agreeably, therefore, to the universal law the uterus must be now liable to direct disease, and to morbific reflex nervous actions from diseases of other organs; while primary diseases of the uterus, in their turn, develop sympathetic affections in other and distant parts. Diseases of the digestive organs inflict diseases upon the womb, and menstruation is suspended as one of the consequences. Again, when the uterus is most actively engaged, as during menstruation, it should, according to our principles, be most liable to disturbance, either from the direct operation of foreign causes, or from reflex nervous influences of other diseased organs. Accordingly, even exposures to a chilling atmosphere, damp and cold feet, &c., will so disturb the uterus, when engaged in excreting the menses, as to arrest its function. And what are the frequent consequences? A long chain of sympathetic diseases, which, from the beginning of their primary cause, we might as well attempt to explain by lunar influence, or by the ebbing and flowing of the tides, as by any principle in the humoral pathology, or by any laws that rule in the world of dead matter. And yet does the intellectual world abound with physical hypotheses of life and disease for the interpretation of phenomena of which those now under consideration are only simple elements. Now, too, the mammæ, for the first time, have their organic powers brought forth, to be in readiness for the secretion of milk. And mark, as we go along, the harmony of Design, and the coincidence between the preparation of the mammæ and that of the uterus. The development of the latter takes the lead, while that of the mammæ is the work of sympathy, and this ascendency is maintained in the pregnant state. And yet we are told that final causes should have no place in philosophy. But the mammæ, like the uterus, now, and for the first time, become the seat of morbid conditions; and, from what we have seen of their natural relations to the uterus, we readily comprehend the reason why they inflame when the uterus undergoes its sudden and violent change in parturition, and why the secretion of milk is now started, and why they are liable to diseases, such as carcinoma, which, at least, seldom occur before this organ is brought under the uterine influences (§ 138, 524 *b*, *d*). How forcibly do all such problems admonish the chemist and physical philosopher to regard all others relative to life, in its natural and morbid conditions, as a part of that great whole, of which the former are only more striking examples!

Again, the testes now, also, for the first time, have their vital state so modified as to perform their function of secreting semen (§ 155). Of course, therefore, for the first time, these organs should be liable to morbid affections, should now, for the first time, sympathize with the diseases of other parts, and inflict reflex actions upon dis-

tant organs. But, besides the general functions, susceptibilities, and influences in which the testes, the uterus, and the mammæ now participate in common with other organs, there are some special characteristics relative to each part that reflect no little light upon our doctrines of life and disease. The development of the testes, for example, exerts a powerful reflex nervous influence on the changes which are simultaneously going on in other parts, as denoted by its well-known effect upon the voice. If the parotids be invaded by mumps, the testes and mammæ are liable to inflame by sympathy, &c. The natural and pathological conditions harmonize together; the latter being strongly associated through the nervous system with the new developments of structure and modifications of the vital states, all of which are owing essentially to alterative reflex nervous influences unceasingly excited by the evolution of the generative organs (§ 516 *d*, no. 6).

From the vital elaborations which are in progress about the face, it is liable to eruptive affections, and the throat to inflammation. Articular rheumatism is now more rife than in childhood, and more so than at any other stage of life. If disposition to scrofula exist, it still manifests itself, as in childhood, in the lymphatics of the neck; but now, especially, it invades the lungs. This, therefore, is the age for tuberculous phthisis. The brain, having already nearly acquired its plenitude of development, and moving on in quiet stability of its organic powers, and the mental faculties employed in undisturbed operations, is comparatively exempt from disease. The passions, it is true, are now at work; but they are not of the morbific kind, either as it respects the brain or distant organs. Anger is the worst, but goes off in explosions. Envy has not been whetted. Grief is transient. Malice has not had its incentives. Avarice awaits the maturity of judgment. Hope and love hold a sway over the whole, and these are conducive to health, when love does not run into excess. Nevertheless, there are transitions from excessive hilarity to the gloom of melancholy, and the mind by fits is fanciful, and by fits is dull. But, by more than all things else, it is subject to depressing influences from the development of the generative organs, and this in proportion to its rapidity; and the state of the mind, as to its dullness, is an index of what is in progress for the procreation of the species. When the organs of generation have attained their maturity, the mind acquires its equilibrium; and its faculties, by this process, have obtained an immense accession to their vigor. These influences are alike felt by both sexes. As youth approaches the adult state, the body, like the mind, increases in vigor, and is capable of all the labor of maturer years. Now is the period for athletic exercise, and feats of strength, and now the awkwardness of youth subsides into the gracefulness and dignity of manhood (§ 237).

4. ADULT OR MIDDLE AGE.

579, *a*. Manhood begins at the age of twenty to twenty-five, and reaches to about sixty years.

579, *b*. At the beginning of this age, all the faculties of the mind are approaching their state of maturity. "He," says Zimmerman, "who, at thirty years of age, is not an able minister, an able general, or an able physician, will never be so." The stature of the body is soon completed, its form perfected and all the organs fully devel

oped. We have, therefore, but little novelty in disease during the age of manhood, except such as may spring from the operation of new accidental causes. The buoyant hilarity of youth is succeeded by greater steadiness of mind, tempered by sobriety and judgment. The passions are now in full operation, and those of the worst kind become more strongly pronounced; of which, avarice and envy are predominant. The disappointments and the trials of life have become manifold, and fall with their heaviest effect; and, as one succeeds another, hope is more or less supplanted by anticipation of evil. The passions, therefore, at this period of life, are of a morbific nature, and lay deeply the foundations of disease, or embarrass the operation of our curative means, and the salutary efforts of nature. Diseases of the digestive organs, especially, and their sympathetic results, are the frequent consequences of grief and disappointment. And, although the appetite has diminished, and is less frequent than at former ages, habits have become more artificial, temperance gives way to excesses, and the activity of youth yields to sedentary pursuits. Numerous arts, and the seductions of the study, call us, also, from the genial influence of the open air, and in various other ways, contribute morbific influences.

Most of the injurious tendencies which are superadded to the age of manhood beset, in the first place, the organs of digestion; dyspepsy being one of the most frequent forms in which disease is now presented, and carries in its train a multitude of sympathetic evils. It is not, however, till the age of thirty-five that these manifestations become common, unless the foundation have been laid, as is frequently the case, by violations of nature in childhood or in youth, or by transmitted predisposition. This is also the period of pregnancy; and, although a natural condition, the artificial habits of society have so modified the natural state of the system, that pregnancy, parturition, and the period of nursing, give rise to no small amount of disease. For the same reason, also, menstruation is often interrupted, while this interruption deranges other organs. Owing, in no small degree, to these acquired peculiarities and the diseases of women, midwifery has become a distinct and important department of medicine. From forty-five to fifty menstruation ceases, and with it the period of childbearing. This new change in the uterus is apt to develop sympathetic disturbances in other parts, and to become a cause of disease in the uterine organs. But, as a compensation, there is now an exemption from those maladies and that suffering which result from the menstrual function.

From the age of 45 to 70, the cerebral veins take on that peculiar modification of congestion which results in a secretion of blood, and which, as occurring in the brain, determines the common form of apoplexy. This condition decreases toward the age of 70. But, I shall not dilate farther upon the peculiarities of this era of life, since they are all referable to the great principles which govern the characteristics of every other period, and all require the same considerations in the aspects of pathology and therapeutics. As at all other stages of existence, also, the characteristics of manhood are gradually changing till they are finally blended or disappear in those of old age, or that stage of life when it is very erroneously supposed that "*the machine is wearing out*" (§ 237, 581 *b*, 584 *b*, 633).

5. OLD AGE.

580. The last period of life has been subdivided into *incipient* or *green old age*, which extends from 60 to 70; *confirmed old age*, or *caducity*, from 70 to 85; and *decrepitude*, from 85 years, upward.

581, *a*. More remarkable changes now take place in certain parts of the organization than from the beginning of youth upward; but, as they occur not in the essential organic parts, modifications of the organic properties and functions are less the cause of certain prominent phenomena than the physical deviations in comparatively unessential parts; such as ossification of the cardiac valves, of the arteries, &c. The senses are failing as an avenue of knowledge. The eye becomes dim, and the ear is only arrested by acute, or distinct, or loud noises. The motions of the body are slow, the back stiff, and more or less curved. The intervertebral cartilages, also, shrink, and the stature lessens in consequence. The joints and tendons become rigid; the sutures coalesce; the skin is darker and more wrinkled; the fat retires from the circumference to the internal organs, by which the superficial veins are rendered more prominent, and the eyes sunken.

581, *b*. Nevertheless, rigidity and other changes go on in the most essential organization, which are principally characterized by a natural decline of the vital properties and functions; but none are abrupt, and there are no new functions introduced, and none are arrested. All these new conditions, too, as at all other stages of life, are the work of the organic properties,—always creative, but ultimately giving rise to physical changes of a suicidal nature, and which end in their destruction. Irritability and sensibility are, therefore, upon the wane, and mobility is alike embarrassed by the foregoing physical changes. The nervous system has mostly played out its part.

581, *c*. The mind, too, in ordinary cases, is going with the organic powers; but it is worth observing, as a characteristic distinction between the soul and the organic properties which animate its abode, that genius rarely wears out. It sparkles as bright as ever when the flickering lamp of life is but dimly seen.

581, *d*. The decline of the mental powers is accompanied by a subsidence of the passions; and as sensibility also fails, former morbific causes and avenues to disease are thus greatly diminished.

581, *e*. The old man waits his certain doom in calm serenity, or only impatient for its approach. He is satiated with the pleasures of life; perhaps because he can enjoy no longer. His reminiscences are rather of his pains than of his delights, because the former are more indelibly established, and are not now counteracted by present enjoyments.

582. From what we have now seen of the physiological conditions of old age it is evident that diseases vary but little from those which prevail after 40 or 45 years; only from the gradual embarrassments sustained by the organic powers disease is apt to be less violent, while, also, for the same reason, there is less of the recuperative ability. Apoplexy, palsy, organic affections of the heart, and urinary difficulties, are the predominating accidents of old age.

583, *a*. Although, therefore, morbific causes are less energetic in old age than at other stages of life, remedial agents are, also, less op-

erative, nature less recuperative, diseases less easily arrested, are sooner beyond the reach of art, and often eventuate suddenly in death, without having attained any degree of severity. Life often snaps when the old man is quaffing his wine, or as he "shoulders his crutch to show how fields were won."

583, *b*. Hence it is apparent that remedies must be prompt and efficient in proportion to the exigencies of disease; as is more extensively set forth in the article on Bloodletting (§ 1014).

584, *a*. Finally, it appears from the characteristics of life at its various stages; the progressive variations in the vital states; the successive developments of important organs; of the new functions which are instituted and again extinguished; till we come to that period when the properties of life lay the foundation of their own ruin by instituting disorganizations of structure; and from what, also, we have seen of the corresponding modifications of disease at the various eras, and of the new ones which appear, with their new train of sympathies, it is obvious, I say, that there must be some corresponding variation of treatment which may be relative to a common character of disease (§ 117, 134–160). But, at every varying stage of life, all things proceed upon established laws; and, however modified the powers which may be in operation, and by which every result is brought about, and whether so by nature, or by morbific causes, or by art, there are precise laws by which all the phenomena are determined according to the particular combination of existing circumstances. It is an important object of art to find out all the conditions which may attend any given state of the properties and functions of life, whether natural or morbid, that the most appropriate regimen may be adopted, or remedial agents be applied with the greatest precision. In all this the nervous system demands a critical attention.

584, *b*. Every remedy would always operate in one uniform way, were the conditions of the vital properties and functions, and the structure which they animate, always the same; just as the blood always affects the heart and vessels in one uniform manner, in health. But, such is the instability of the properties of life, and such, in consequence, the variableness of morbid conditions, that these modifications are rarely precisely the same in any two instances, or at any two successive days. To find out these varieties, and to adapt accordingly the general principles of treatment, and in their relatively specific details, is one of the highest and most difficult aims of medicine; and demands, as an indispensable qualification, a profound knowledge of the philosophy of life.

II. INDIVIDUAL AND GENERAL PECULIARITIES, CONSISTING OF TEMPERAMENT, CONSTITUTION, IDIOSYNCRASY, AND NATIONAL ATTRIBUTES.

A. *Temperament, Constitution, Idiosyncrasy.*

585, *a*. Under our fifth division of physiology we have next in order the *Temperaments*, &c., or those peculiarities of life which naturally distinguish one individual from another. The temperaments, therefore, may be regarded as embracing the innate as well as acquired peculiarities of constitution; for, although the latter depend upon causes that are relative alone to the individual, the former, or innate constitution, has been brought about, at some anterior genera-

tion, by the physical agencies of life. This is the true temperament, and belongs to masses of mankind.

585, *b*. *Idiosyncrasy* is only a variety of temperament and constitution, and like those, therefore, depends upon some peculiar modification of the properties of life, especially irritability; but only so in relation to a very few particular agents. It is peculiar to individuals, rather rare, and may be hereditary or acquired. This peculiarity is not unfrequently the cause of the favorable or deleterious effects of certain remedial agents, of certain kinds of food, &c. We see the important principle illustrated every day, every hour. Here is a subject who is salivated by the external application of a few grains of mercurial ointment, and in whom syphilis, or fever, may be speedily extinguished by this simple use of the remedy. But here is another, in whom the internal administration of an ounce of calomel may produce no constitutional result, and make no impression upon syphilis. Or, it may be in another case of extreme susceptibility to the action of mercury, that the agent always displays the effects of a profound poison, aggravating fever and syphilis, or, in the absence of disease, greatly deranging all the functions of life. Most men are poisoned by the slightest contact with the rhus vernix; but now and then an individual handles it with impunity. Muscles, and some other animals, are always poisonous when eaten by some people, though generally good articles of food.

585, *c*. *Constitution* comprehends all the peculiarities of the individual,—the temperament, idiosyncrasy, conditions relative to age, sex, habits, &c. It is therefore liable to many variations at all periods of life. The prevailing characteristics of each of the elements may remain, but yet so modified that what is known as constitution may be "broken down."

585, *d*. The same principle is concerned throughout, whether in respect to *constitution*, *temperament*, or *idiosyncrasy*. It is the same as prevails habitually in respect to the naturally modified irritability of different organs in man, and in all animals, and in plants; that which renders urine innoxious to the bladder, but morbific to all other parts,—that which renders the eye susceptible to the undulations of light, the ear to the undulations of air; and so on (§ 133–159). The principle, and its everlasting, unchanging laws, are every where, in all that relates to organic beings, whether in respect to the system in its abstract condition, or as relative to external agencies. It is a great and wonderful principle, a perpetual study for the philosopher, ever pregnant of variety, ever illustrative of the peculiar character of the properties of life, of their natural modifications, of their instability, and forever supplying fresh sources of interpretation of the laws which the properties and actions of life obey.

586. It is evident, therefore, that temperament, constitution, and idiosyncrasy, are constituted by certain acquired or transmitted conditions of the vital properties, which form a part of the natural or habitual state of each individual, and from which arise various degrees and kinds in the susceptibilities to the action of physical agents, and certain peculiarities, also, in the material condition and conformation of parts, especially the external. By studying these sensible peculiarities, as well as the phenomena of life in their natural and morbid conditions, we infer the peculiarities of the natural vital conditions in dif-

ferent individuals, or their natural constitution and temperament, or any more remarkable idiosyncrasy. They reach, also, to the mind, which is apt to bear certain relative peculiarities to those of the organic states.

588. In the farther consideration of this subject, I shall regard those peculiarities of constitution which are mostly of a determinate nature, and include them under the general denomination of temperament.

589. The physiological differences between temperament, idiosyncrasy, and constitution, are neither great, nor of much practical importance. Indeed, so allied are they in principle, that a common philosophy determines the remedial treatment, which is always more or less modified by temperament. Each should be considered along with the modifying influences of habits, climate, &c.

590. Temperament and constitution do not depend, as supposed by some writers, upon the special development of particular organs; though this is true of some of the vicissitudes of age (§ 153–159, 596). The former have their foundation in the system at large, and are apt to be transmitted by one or both parents; or the transmitted peculiarities may come from a remote ancestor, and not from the immediate progenitor. This last peculiarity is analogous to one of the characteristics of the scrofulous diathesis, where it passes over one generation and reappears in the third.

591. It appears, therefore, that temperament, whether innate or acquired, is due to the slow operation of causes upon the vital constitution; just as we have seen of the law of *vital habit* (§ 535–568). In the latter case, the modifications are more or less transitory; but may be so ingrafted as to be transmitted, for a time, like the permanent temperaments, from parent to child, as seen of some diseases, such as lues, or of predispositions to disease of a transient nature, as in smallpox, or even ordinary fever. Coming to hereditary disease of a permanent nature, as scrofula, we run from the transitory phenomena of vital habit, by an intimate analogy, into the permanent temperaments; and from these we are conducted by the same philosophy, which respects the operation of physical agents in modifying the properties of life, to those more remarkable peculiarities which spring up in animals from domestication, and in plants from changes of climate and soil (§ 75–80, 143–147, 220, 327–331, 559, 561–563, 659, 666 *b*, 674).

592. It is scarcely probable that differences in temperament have, often, any appreciable effect on the elementary composition. Differences, however, obtain in respect to structure, as seen in the general form, the proportions of the limbs, the features, &c.; while more remarkable corresponding analogies are witnessed in the herbaceous and arborescent habits of the same plant, as it may be subject to the influences of a tropical or cold climate, as the ricinus communis (§ 538).

593. Great differences arise not only in respect to the influences of the same remedial agents from the mere circumstances of temperament, but morbific causes may be equally various in their operation. The same causes may also be very apt to affect one temperament, while they will rarely have an effect on another temperament (§ 142 145, 740). The nervous system is much interested in those modifications.

594. The temperaments, as designated by the ancients, and retained by the moderns, are divided into the *sanguine*, the *melancholic*,

the *choleric*, and the *phlegmatic*. The artificial habits of the moderns have added a fifth, or the *nervous*.

595. It is not usual to find all the attributes of each temperament united, while some of the whole may be blended in the same individual. Nevertheless, the characteristics of one or another generally predominate.

596. Temperament is most distinctly pronounced at adult age, after the influences of development have ceased (§ 590).

1. THE SANGUINE TEMPERAMENT.

597, *a*. Unlike the other temperaments, the characteristics of the *sanguine* are perpetuated from infancy, and perhaps, therefore, may be considered the most natural. The skin remains soft and delicate; the limbs rounded and full; the superficial veins, unlike those of infancy, large, conspicuous, and blue, especially about the head and temple; the complexion fair, florid, and animated; the eyes large and blue; the hair light, or red, or of intermediate hues.

597, *b*. Sensibility and irritability are strongly pronounced; the great development of the latter giving the principal determination to the sanguine temperament. The blood, in consequence, stimulates the heart to more frequent, high, and regular action, maintains the capillaries in a lively and plethoric state, and thus determines the redness and softness of the skin. Other vital stimuli also operate with greater intensity than in other temperaments. For the same reason, the secretions and excretions are rapid and copious, and are little liable to vacillation, in the ordinary conditions of health. All things else move on in a corresponding manner; the whole assemblage of which beautifully illustrates the true philosophy of life.

The great development of sensibility contributes, also, its considerable part to this temperament. The senses are ever on the alert; and here, as with irritability, external objects make their impressions with great effect and rapidity. Perception is rapid, reflection quick, imagination lively, memory prompt. The succession of ideas is too rapid for comparison, and hence the judgment is infirm, unless associated with genius; when it is distinguished for eccentricities. This is exemplified in the poet, Byron, and in the warrior, the Marshal Duke of Richelieu,—"that man, so fortunate and brave in arms, light and inconstant, to the end of his long and brilliant career."

597, *c*. Inconstancy and levity are the great moral attributes of the sanguine. Variety and enjoyment never satiate. Devoted to sensual gratifications, they are in love with all female beauty, and are inconstant to a mistress, if not to a wife; yet are they honorable in all things else. It has been said of Newton, that he was of the sanguine temperament; but, had he been so, it is replied, "he never would have carried, as he did, his maidenhead with him to the grave, at the age of fourscore." Nor do the senses afford that leisure for profound meditation, nor admit of those intellectual operations which are indispensable to the mathematician and astronomer; whose habits, also, are more adverse to this than to any other temperament.

The sanguine is eminently generous or prodigal, and the end of gain is the purchase of pleasure. Quick in anger, he is soon cool; or he is impelled to hasty decisions that are soon regretted. A challenge to a duel would be gladly abandoned, did not a sense of pride

urge him on to the combat. Revenge and envy have no hold upon this constitution.

597, *d.* It is evident, therefore, that the prevailing diseases of the sanguine temperament are active and inflammatory; that the organs sympathize readily and greatly with each other, and that the sympathetic affections are disproportionately greater than the primary affections. Infancy always partakes of this temperament; but if it be truly constitutional, the infant is liable to extraordinary demonstrations of its fundamental nature. The irritation of a tooth, for example, is more apt to produce convulsions, and intestinal derangements still more so, or to lay the foundation of cerebral disease, &c. At adult age, slight disturbances of the womb bring on hysteria, or indigestion contributes to a more sudden accession, more violent phenomena, and a more rapid progress, and lights up the flame of other diseases more speedily, and more violently, than in other temperaments. Anger, being quick and vehement, here displays its instant effect in developing inflammations, and hemorrhages. But love is too instable to undermine the health; and as envy, grief, and jealousy, torture not the mind, so do they not the body. The nervous system is in lively force.

597, *e.* As external causes, whether natural or morbific, make their impressions rapidly and profoundly upon the sanguine temperament, and its diseases being active and violent, remedial agents should be prompt, and decisive, as in infancy; but here, also, for the reasons which are relative to the first period of life, and for such as are assigned in section 597 *b*, remedies are also profound and speedy in their operation. And since the prevailing disease of this temperament is inflammation, bloodletting is the principal means of cure, and will require but little co-operation from other agents. If early applied, and carried to its proper extent, it will often nearly extinguish the most violent inflammations during its first application. The test of this extent will be also more exactly determined in this than in other temperaments by the subsidence of symptoms during the progress of the operation. It is in this temperament, also, that the philosophy of the vital influences of loss of blood is most evidently shown (§ 191), and morbific and therapeutical aspects of reflex nervous actions.

2. THE MELANCHOLIC TEMPERAMENT.

598, *a.* The *melancholic temperament* has certain points of resemblance to the sanguine, though they are strongly contradistinguished. The general external aspect of the latter is cheerful; that of the melancholic, dry, stern, or gloomy, and excites no liveliness in others, though it command respect and even admiration. The solids predominate in the melancholic; the capillaries show less blood, though the veins are large and more prominent, but less transparent than in the sanguine; and, unlike the latter, the skin is darkish, or inclining to yellow, thick, coarse, and hard to the lancet. The blood flows more freely from the sanguine when the skin is pricked; and this exemplifies the state of the capillary circulation at large. The same principle obtains, therefore, in the pulmonary circulation, and hence, in part, the blood is darker in the melancholic than in the sanguine. The eyes of the former are darker and less prominent than in the latter; and the hair is dark, coarse or stiff; eyebrows large, black, and often projecting; the muscles and tendons, like the superficial veins

stand out, from the absence of that cutaneous fat which gives rotundity to the body of the sanguine (§ 440 *bb*, 440 *c*, no. 11½, 441 *c*).

598, *b*. It is easily seen, therefore, that irritability and sensibility are comparatively dull in the melancholic. External objects do not make the strong and rapid impression upon the senses as in the sanguine; and, from the obtuseness of irritability, the action of the heart is slower, the capillary blood-vessels are less charged with the vital fluid, the secretions and excretions less, and more slowly performed (§ 191). The nervous system evinces great stability of functions.

598, *c*. The melancholic temperament is the principal abode of genius; embracing a large proportion of those great men who have unfolded the laws of nature, or have made the highest advances in the arts, or have astonished the world with deeds in arms, or with the achievements of the statesman, or the orator, or the painter, or the poet. The melancholic is the man of men. I had almost said, in moral constitution, he is perpetuated, unchanged, from the model of his race. Here is witnessed the highest intellectual renown at the very dawn of manhood; and here it is that we so often meet with genius struggling with those adversities which arrest the ambition of other temperaments. The melancholic is forever indomitable; rising in determination as obstacles rise before him. Inflexible in purpose, the passions are disciplined to urge on an arduous enterprise, or if allowed to become impetuous, it is to accomplish the decisions of the understanding. With equal facility he concentrates his mind upon abstract inquiries, or at the next moment sends it abroad over the widest theatre of its operations. He is bold and brave, never fearing death, nor wantonly incurring danger. He moves steadily forward, though he does not move till the path before him has been explored. His imagination, therefore, is of the highest order, being disciplined by the sterner faculties. It is such an imagination as is always an element of genius; such as contemplates the realities of life and the truths of Revelation. He is thoughtful, grave, or sad, but may tune his mind to great elevation and great sublimity and enthusiasm, and often soars on poetic wings through the regions of Heaven. The sanguine, on the contrary, delights in the romance of fiction.

Honor holds its empire in this temperament, however it may be wanting in human sympathies. If pledged to a good or a bad action, it is fulfilled. The melancholic is generally fervent but dignified in his attachments, or looks with indifference or with scorn upon humanity. A few, like Tiberius, are fearful, perfidious, suspicious, and cruel; and others, like Nero, or Richard, insensible to danger, and ever ready for the work of death.

598, *d*. As with sensibility and irritability in their natural aspects, so is it in their relation to morbific and remedial agents. The coincidence is universal. The former are slow in establishing morbid changes, many are inoperative which readily light up the flame of disease in other temperaments; and the passions, a prolific cause with others, are subdued by the melancholic into mere agents of the understanding. But when morbific causes have made their impression, the dullness of irritability and mobility explains why disease is apt to be obstinate, and why remedial agents operate with less rapidity than in the sanguine. The vital properties and functions being slowly susceptible of morbid changes, they are slowly altered from their morbid states, and with this coincide the actions of the nervous system.

It is easily inferred that the diseases of the melancholic are mostly of the digestive organs, and that their removal is tedious. It is also manifest that these, and other affections, are slow in developing dis eases of other parts, and that the brain and the mind must be most likely to sympathetic disturbances. Hence it is that hypochondriacism and insanity are apt to supervene on the melancholic temperament.

Cathartics are demanded more by the melancholic than by any other temperament; though their exigencies have a special relation to the disorders of the digestive functions. Bloodletting, also, is often necessary to reach these chronic maladies; and, although its delay in the grave forms of inflammation be less hazardous than with the sanguine, its necessity is as great, and its extent and frequency of repetition are greater. It is here, too, that the greatest demand is made upon the materia medica for auxiliary means.

3. THE CHOLERIC TEMPERAMENT.

599, *a*. The *Choleric* is intermediate between the sanguine and melancholic temperaments; and although it form the sanguineo-melancholic, it possesses characteristics which give to it an individuality.

The skin has greater fullness of the capillaries than in the melancholic, and therefore greater softness, and warmth, but less than in the sanguine. The pulse is intermediate in fullness and frequency. The secretions and excretions moderate and uniform; the healthy functions performed with regularity and ease.

599, *b*. The passions are easily roused, though not impetuous, and therefore less transient and less easily appeased than in the sanguine, though not so persevering as in the melancholic. The choleric is tenacious of his own rights, but less disposed to infringe upon the rights of others than the melancholic, while he has less generosity than the sanguine. The higher faculties of the mind correspond with the other characteristics of this temperament, being generally distinguished for their moderation.

599, *c*. Irritability and sensibility holding an intermediate degree between those of the sanguine and melancholic, external agents operate with a relative effect and rapidity; so that the organic functions move on without frequent or profound interruptions, and diseases yield to a more compound treatment, though less readily than to the simpler means required by the sanguine, but more speedily than in the melancholic.

4. THE PHLEGMATIC, OR LYMPHATIC TEMPERAMENT.

600, *a*. The *Phlegmatic* is characterized by slothfulness of mind, and by a simpler display of vegetative life than any other temperament. The flesh is soft, the countenance pale, the hair delicate, and the fat amounts to an encumbrance. The limbs are rounded, feeble, and without expression. The veins are small, and lie deep. The pulse is small, feeble, and soft; arteries small, and the capillaries deficient in blood. Irritability is dull. The secretions and excretions are performed slowly, and their products are thin or watery. Sensibility is also obtuse, and perception weak, which greatly circumscribes the senses as an avenue to the mind; while

"Fat holds ideas by the legs and wings"

(§ 440 *bb*, 440 *c*, no. 11½, 441 *c*).

But, with all the intellectual dullness and bodily indolence which distinguish this temperament, it is obstinate, fearful, suspicious, and avaricious. The nervous system is blunt and on the side of evil.

600, *b*. The organic properties of the phlegmatic are easily liable to interruption, though morbific causes, unless intense in their nature, make their impressions feebly. The mind, and its predominant passions, have, of course, but little agency in the production of its diseases. Disturbances, however, seem to arise from the mere inertia of the vital powers; and when morbific causes make strong impressions the properties of life often go down at once to near the verge of extinction. So, also, do active remedial agents operate with a relative effect. Emetics are scarcely admissible; violent cathartics prostrate excessively; and any unnecessary extent of bloodletting breaks down the whole energies of the body. This temperament, therefore, requires great moderation of treatment (§ 150).

5. THE NERVOUS TEMPERAMENT.

601, *a*. The *Nervous temperament* displayed itself feebly among the ancients, but has been brought to a high maturity by the progress of civilization. It is the only temperament where the primary causes may be traced, which consist mainly of such as are attendant on indolence and sedentary pursuits. It involves alike, therefore, the rich and the poor, the sensual devotees of fashion and the plodding shoemaker, the laborious student and the readers of romance.

601, *b*. The nervous temperament is founded upon the sanguine, or the sanguineo-melancholic, and is either transmitted, or springs up originally in the individual. It is therefore the most artificial of all the temperaments, and is susceptible, individually, of great improvement. It is shown externally by a general aspect of feebleness, a spare body, and small, soft muscles, which are incapable of much exertion.

601, *c*, Disturbing reflex nervous actions are the leading characteristic. Irritability is also strongly pronounced. Hence, slight disturbances, even of unimportant parts, give rise to greatly disproportionate sympathies in the more important organs; and these secondary results will be still more intense if the primary disease be seated in any important organ.

The functions are constantly subject to irregularities, especially those of the abdominal viscera. If the subject be addicted to the causes of this temperament he is rarely free from indigestion, and an attendant train of other evils, according to the nature of his indulgences or pursuits. Diseases, however, are not as violent as with the sanguine, nor as profound as with the melancholic. The mind is irritable, but the passions not violent, though they readily disturb the organic functions. Such as display themselves depend much upon the habits and occupation of the subject.

601, *d*. Remedial agents operate with power; the same coincidences existing between their effects and those of a morbific nature, as in other temperaments. Moderate impressions, therefore, made upon the intestinal canal are sensibly felt by remote parts; and in this temperament, particularly, the peculiar principle upon which leeching operates is well illustrated (§ 145, 147, 914, &c.).

General Remarks on Temperament.

602, *a*. Different epochs of life appear often to partake of a particular temperament; one subsiding into another. The sanguine is most characteristic of infancy and childhood; the melancholic and choleric of middle age; and the phlegmatic of old age.

602, *b*. The several temperaments are also often blended, more or less, with each other in the same individual, though the characteristics of one generally predominate. When combined in the same individual, they are called the sanguineo-melancholic, the sanguineo-phlegmatic, &c. They are also liable not only to the foregoing modifications from age, but from sex, climate, habits, education, &c. So great, indeed, is the influence of climate, that a change of residence (as from a northern to a tropical country) will sometimes gradually transmute one temperament into another; and this is particularly true of the sanguine, the melancholic, and the choleric.

602, *c*. The foregoing accidental influences are sometimes such as to generate anomalies, in which it is difficult to recognize any distinct features of the prevailing modifications of temperament, and which may disappear with the individual, or be transmitted to his descendants.

602, *d*. All the varieties comprehended in this section are more or less liable to modifications of a common form of disease, and require corresponding variations in the details of treatment. They concur together, therefore, in forming a part of the difficulties of medicine, and in demonstrating the complete abstraction of organic beings from the forces and laws of the inorganic (§ 659).

603. I say, organic beings in their most comprehensive sense (§ 602, *d*). For are not the varieties which have sprung from domestication, and cultivation, among animals and plants, and which are equally, and more perfectly transmitted than temperament, constitution, &c., in relation to man, integral parts of a common principle? Exactly the same philosophy lies at the foundation of the whole, and is another broad field of evidence to substantiate the unity of the Vital Principle, of its common laws and functions throughout animated nature, and presents the whole in a magnificence of Grandeur, a Harmony and Unity of unfathomable Designs, which stamps an unutterable contrast on the confusion and imbecility of the chemical and physical hypotheses of life. (See *Climate*.)

B. *Races of Mankind.*

604. Corresponding, in principle, with Temperament, &c., though different in their manifestations, are those peculiarities which have distinguished mankind into various *Races*. They correspond more nearly, in the physical characteristics, with those sensible changes which are established by the domestication of animals, and by the cultivation of plants (§ 603). As with many species of the latter, the varieties of mankind have existed without change as far back as history begins its record. This circumstance has often led the speculative mind to imagine as many original ancestors as it may distribute the human species into varieties of race (§ $350\frac{3}{4}$, *kk*). But, with exactly the same reason may we assume that the black and the white barn-yard fowl, and all the other varieties of this animal, or the red

and the white potato, and other varieties of this root, the sloe and the plumb, the crab and the apple, are equally distinct, and that each has descended from a distinct original progenitor. Or take the yet more remarkable transmutation of a salt and bitter weed into the varieties of the cabbage and cauliflower by transplanting it from the sea-shore into the rich mold of gardens, and which are as dissimilar as each from the original species.

605, *a*. The attributes of Race are mostly of a physical and moral nature; and, unlike the temperaments, but analogous to the foregoing varieties of animals and plants (§ 604), they are not attended by any special modifications of the properties and functions of life; but all the races are liable, individually, to the physiological conditions of temperament. The general attributes, therefore, admit of no physiological, pathological, or therapeutical applications.

605, *b*. And here it is worthy of remark, as illustrative of the common nature of the properties and functions of life, that other changes to which animals and plants are liable from unaccustomed physical agents are attended by distinct modifications of their vital states, and remarkable variations of structure. An animal, for example, transferred from the tropical to colder regions, undergoes a change in its hairy or woolen vesture, or from summer to winter in the same climate. The tree, transplanted from the tropics to a northern latitude, may be made to resist the inclemencies of winter, and finally puts on a denser bark, and a hibernaculum for its leaf and flower-buds. Or yet more strikingly, what is herbaceous in equatorial regions may become a shrub or a tree in temperate climates. These mutations, therefore, are strictly analogous to the temperaments of man. Or, again, what is more emphatically characteristic of the analogies of nature in any of her grand departments consists in the fact that the varieties which are constituted by hybrid animals and plants are, equally with the foregoing, both in respect to cause and effect, corresponding phenomena with the varieties of temperament (§ 72).

606. From what is known of the analogous varieties among different species of animals and plants (§ 604), we shall have little difficulty in referring the characteristics of race to the influence of physical agents upon the properties of life; and of these there are none so obvious as climate. Like temperament, &c., the whole falls under the laws of vital habit (§ 535, &c.).

607. Perhaps there is no better classification of Race than Lacépède's; who reckons only the European Arab, the Mogul, the Negro, and the Hyperborean. These have been variously subdivided.

Blumenbach's division of the races is also simple and just; namely, the Caucasian, the Mongolian, the Ethiopian, the American, and the Malay. The Caucasian variety answers to the European Arab of Lacépède; the Mongolian to the Mogul; the Ethiopian to the Negro; the American embraces all the natives of North and South America, excepting the Esquimaux; and the Malay includes the inhabitants of Sumatra, Borneo, New Holland, and many other islands of the South Sea; most of whom speak the Malay language.

608. The European Arab comprises the people of Europe, Egypt, Syria, Arabia, Barbary, Tartary, Persia, the North American Indians, &c.

The fundamental characteristics are an oval face from forehead to

chin, a prominent skull anteriorly, a long nose, skin more or less white, and long, straight hair.

609. The Mogul race is composed of the Chinese, the inhabitants of Eastern India, Tonquin, Cochin China, Japan, Siam, and the South American Indians. This race is more numerous than all the others.

Its characteristics are a flattish forehead, eyes turned rather obliquely outward, cheeks prominent, oval face between the two cheek bones.

610, *a*. The Negro, a native of Africa, possesses the most perfect characteristics. The black skin, the low, flat forehead, the depressed nose, the thick lips, the crisped hair, the dullness of understanding, and the acuteness of his senses, mark him as the greatest phenomenon among the physical changes of our species. This is the only race of whom it can be surmised that the change has been miraculous.

610, *b*. The bondage to which the Negro has been subjected has naturally excited the sympathies of the humane, and has led them to assume in his behalf an ideal rank in the scale of mind. I would not oppose this harmless prejudice were it not in collision with fundamental laws which it is my duty to interpret, as far as may be, as nature teaches. The brain has sustained in this degraded race (degraded as well by nature as by man) that failure of development, which, as universally admitted, stamps the white man with intellectual inferiority. But, degraded as is the Negro in mind, in body, and in bondage, he is yet a man, and, like the rest of the human family, descended from common parents. His very imbecilities, therefore, entitle him the more to our sympathies and protection (§ 1078, *s*).

611. The Hyperborean stands, also, in strong relief from the rest of mankind. This race comprises the Laplanders, the Esquimaux, Samoiedes, Ostiacs, Tschutski, &c.

They have broad faces, flat features, swarthy skin, and are stinted in growth. In the scale of intellect they rank next above the Negro.

III. SEX.

612. Certain physiological differences in the sexes appear to have been impressed originally upon the constitution; and this, indeed, was necessary to the perpetuation of the species. But, although our first parents were created in a state of maturity, there were ingrafted upon the constitution (§ 64 &c.) the laws of development for natural growth, and which are designed to conduct the individual to that mature condition in which he came from the Hands of the Creator.

613. Besides the special difference in the organs of generation, woman is of a lower stature than man, less rigid in organization, softer and more delicate in her skin and complexion, abounds more with cutaneous cellular tissue and fat, (§ 440 *bb*, 440 *c*, no. $11\frac{1}{2}$, 441 *c*), which gives greater rotundity to her limbs and greater concealment to the muscles. Laws of nervous system more strongly pronounced.

Her mind is quick in its operations, arrives earlier at maturity, but is less vigorous, than in man. The passion of love, although indomitable, is more a sentiment with her than with the other sex. She seems, however, especially designed for the reproduction of the species, and for the early care of her offspring.

614. Sensibility, irritability, and therefore mobility, are more exquisite than in the male, and, for a like reason, she is more susceptible, as with the infant, and the sanguine and nervous temperaments,

to the action of morbific causes. Sympathy predominates, also, in the female; and hence local diseases are more apt, than in the other sex, to disturb other parts. But she is not, therefore, more liable to death; since the vital powers being more strongly pronounced, they are more recuperative, and the same susceptibility to morbific causes renders her, also, more susceptible of the genial effect of remedial agents. What Providence has denied to one, He has given to the other.

IV. CLIMATE.

615. The influences of climate in modifying the physiological character of man are great and various, and still greater and more various in predisposing him to disease. The physiological effects of climate are also strongly shown in animals, though often far less in their organic than their animal economy; while in the vegetable tribes these or analogous results are often strongly manifested in organic life. The nervous system takes its usual modifyiug share (§ 578 *d*).

616. I shall speak now mostly of those permament effects of climate which are known under the denomination of temperaments, for the purpose of illustrating still farther the radical changes which may be established in the vital states by physical agencies (§ 585–603). This, also, will show how profoundly climate may operate in disposing the organic functions to a state of disease, and will contribute, with what has been said in other places, in inducting us into a knowledge of the philosophy which relates to predisposition to disease.

617. The extremes of heat and cold are conducive to the formation of the sanguine temperament, either in maintaining it as an inherited peculiarity, or in developing it out of other constitutions. But, it is mainly the dry heat of the tropics which goes to the formation of the sanguine temperament. The phlegmatic and sanguineo-phlegmatic belong mostly to warm climates, especially to such as are moist. The choleric and melancholic occupy the temperate regions; and here, therefore, we may look for the demonstrations of genius. The choleric and melancholic gradually merge into the sanguine, or phlegmatic, in tropical regions (§ 1047).

618, *a*. The philosophy of life, as already expounded, enables us to comprehend the manner in which the foregoing transitions and varieties are brought about; while the changes confirm that philosophy (§ 617). Thus, when the melancholic migrates from the temperate to a tropical climate the uninterrupted and powerful action of heat upon irritability and sensibility renders these properties more and more susceptible to the action of blood, and all vital stimuli. The secretions and excretions become, in consequence, more abundant; morbific and remedial agents manifest corresponding variations in effect; and since, also, the organic properties of the brain sustain the modifications incident to other organs, and the senses acquire greater liveliness, the whole character of the mental faculties takes on that of the sanguine temperament, and what was once an uninterrupted effulgence of mind dwindles down to occasional scintillations. This is especially the course of the transplanted melancholic if the temperament incline to the sanguine. But here, as with the choleric, or where the sanguine and melancholic are distinctly associated, if the temperament lean to the phlegmatic the vital properties are rather

depressed by heat, and the functions of the body and mind are more slowly and feebly performed; being influenced even by the vicissitudes of season, and by the daily atmospheric changes.

In the tropics, therefore, man is indolent, given to pleasure, and lives only for himself. With the natives of high northern latitudes the properties of life are under the perpetual influence of cold, which fails, in consequence, of its usual action as a stimulus in temperate climes, and all the functions are slowly performed; save only the generation of heat, which has its special final cause. Growth must therefore be slow and stinted, and there must be (*cæteris paribus*) great capability of resisting morbific causes, and a gradual recovery from disease. As the temperate climates hold an intermediate rank in their vital relations, it must be here that we shall find mankind representing the most perfect attributes of their nature.

618, *b*. The same philosophy holds in respect to animals and plants, since all observation teaches that they are as sensibly affected, in certain aspects, by the diversities of climate, as the human race; being, also, like man, subject to modifications from education, soil, &c. (§ 605, *b*), allowing for differences in organization and life (§ 185).

619. We thus see that climate contributes largely to the formation of temperament, and exerts direct modifying influences upon the general character of disease. In this last acceptation it embraces all the predisposing causes which appertain to different regions; such as the various kinds of miasmata, temperature in its general aspect and as liable to vicissitudes, moisture and dryness, and other obvious conditions. Physiological principles lie at the foundation of the whole.

620, *a*. From the considerations which have been now made, as well as for other reasons, chronic diseases should abound in the temperate zones, while they are comparatively rare in equatorial climates. Consumption is a grand characteristic of the former, especially of the sea-board and other humid regions.*

620, *b*. The principle about which the facts just stated are concerned, as well as others that are relative to climate, is well illustrated by the rapidity with which the chronic maladies of horses yield to tropical influences; a large proportion of these animals which are destined for the West India markets being thus affected, and thus relieved.

621, *a*. The remarks which have been now made in respect to climate lead me to indicate an important duty of the physician as it respects the inhabitants in an individual sense; though I have in view its philosophical as well as practical bearing.

* True, it has been lately stated on the authority of the British Army Statistics, that consumption is more rife on the West India stations than in any other quarter of the globe; from which the conclusion was drawn that the disease was especially incident to those climates. This important fallacy I have pointed out in the Medical and Physiological Commentaries (vol. ii., p. 619-622). In that work, also, especially in the Essays on Bloodletting, and on the writings of M. Louis, I have set forth the facts, which, with the preceding, and others of a coincident nature, enforce the importance of rejecting all army statistics, and other hospital reports, as forming any proper foundation for great pathological and therapeutical conclusions; and have endeavored to show that all such conclusions should be drawn exclusively from the private walks of the profession, where the constitution is natural, the habits good, and disease early and judiciously treated, and where, especially, the superintending physician is, bona fide, the prescriber and critical observer, and more anxious for the recovery of his patient than for a *post mortem* examination. Hospital reports represent nature in her most distorted aspects, the treatment of disease being often begun at its moribund stages, and when the system is full of organic lesions: this treatment, too, often experimental, and without reference to fundamental physiological principles (§ 623).

The native and the acclimated are apt to possess very different susceptibilities from the new-comer, from which it results that the treatment of their diseases, respectively, should be more or less governed by these considerations; while it will be, also, the important business of the physician to point out to the stranger the means of averting the new morbific influences to which he is subjected, and his modified susceptibilities. The means are various, and of the highest moment. It was from their neglect, as I have shown, that the mortality from consumption has been so great upon the West India stations, and the Report of which has led to so many theoretical and practical errors (§ 620, *note*). And as to the importance of a proper adaptation of treatment to the acute forms of disease upon the same military stations, it is only necessary to consider the appalling contrast between the results of practice as introduced by Robert Jackson, and that which immediately preceded his superintendence as surgeon-general. By diminishing, also, the allowance of "salt beef and rum" to the sick, he saved the British government $400,000 per annum. And who does not know that it is the same now as in Zimmerman's day? "I know," says Zimmerman, "a certain Esculapius who has fifty or sixty patients every morning in his antechamber. He just listens a moment to the complaints of each, and then arranges them in four divisions. To the first he prescribes bloodletting; to the second a purge; to the third a clyster; and to the fourth change of air! The same vulgar prejudice leads people to have a great idea of the practice of large hospitals. I have seen, in my travels, some of the largest hospitals in Europe; and I have often said to myself, Heaven, surely, will have pity on these miserable victims" (§ 1065 *c*, 1068 *a*).—NOTE F p. 1114.

621, *b*. In connection with the foregoing should appear the modifications which arise from peculiarities in the specific nature of the remote causes of disease, which are almost as various as the causes themselves. We know, indeed, that the pathological cause of inflammation may be varied by the manner in which wounds are inflicted; and more various, therefore, must be the exact modifications which are determined by agents which possess specific properties. To know those modifications presupposes, in no small degree, a knowledge of their special causes. They demand a great versatility of treatment where common principles may apply; and this may be determined more by a knowledge of the remote causes than by any resulting phenomena (§ 644, &c.).

V. HABITS, OR USAGES.

622. It now remains to speak briefly of the last subdivision of our fifth grand division of Physiology. Under the denomination of Habits are included the various pursuits of mankind, their social and political relations and institutions, their modes of living in respect to food, exercise, clothing, &c.; with a special reference to their physiological and pathological influences, which are great and numerous.

Much of this subject is considered under the direct physiological aspect of vital habit (§ 535, &c.), and the same principles obtain throughout. The usages of man not only variously modify his vital condition in a transient manner, but, like the effects of climate, incompatible habits may establish permanent and transmissible changes or constitution. The glass-blower, the brazier, the painter, the type

setter, &c., have, respectively, modifications of a common disease, which are still different from those of the sedentary divine, lawyer, and shoemaker. And so of the various pursuits which demand more or less exercise in the open air.

623. Habits, in their most extended sense, open upon us a field for endless observation. Here it is, in the neglect of the natural means of preserving health, in the pinches of poverty, in the filth of indolence, in Bacchanalian indulgences, and in the various resources of licentiousness, we meet with nature so turned from her physiological condition, that when disease sets in it presents the most embarrassing anomalies. The hospitals of all countries, especially of Europe, show a disgusting amount of these artificial deformities. And yet are they sent forth as legitimate grounds for important conclusions in pathology and therapeutics (§ 620, *note*).

All the foregoing varieties of disease, which grow out of deleterious habits, or pursuits, may yield to the substitution of natural means, or to change of employment.

624. As to the active treatment of the cases last recited, I can only say, that, while the great principles obtain as in less artificial states, they demand greater modifications of practice than all other special conditions that are incident to man. But, let us remember, that when we meet with phrenitis, or pneumonia, or any other grave inflammation, ay, or even erysipelas, affecting the most broken-down constitution of the most dissolute man, stimulants will be pernicious, and he must take his chance from a modified antiphlogistic plan.

625. Under the category of habits may be arranged the modifications which are exerted upon the constitution by subdued diseases. There are many affections which leave their subjects not only unusually susceptible of morbific agencies, but modify the pathological character of the diseases which may subsequently spring up. The dyspeptic affections that follow recoveries from fever are more obstinate, and require a more varied treatment, than such as arise from simple indolence, or even from high living. Syphilis, though cured, predisposes to an obstinate form of rheumatism, which requires a different detail of treatment from that which is induced by cold, or by hepatic and intestinal disease.

625½. The usages and habits of man supply a fruitful field of inquiry into the modifying influences of the nervous system upon his organic states, and for tracing out their analogies with those reflex actions which contribute to the development of structure, and most remarkably at the age of puberty, when the evolution of the generative organs, starting in the same inscrutable laws of organic life as are provided for the analogous organs in plants, establishes that profound labyrinth of reflected nervous actions which bring under their sway the whole animal fabric, and through which we may look as a guide at all the more obscure relations of the nervous system to the organic fluctuations of man and animals, even the exalted grade of their organic compounds, and to which influences are owing, in part, the peculiarities that distinguish the animal from analogous conditions of the vegetable tribes; while, also, we may find in the same pronunciations of the generative organs a clear physiological ground for interpreting the *modus operandi* of morbific and remedial agents and the multifarious influences of organs upon each other either for good or for evil (§ 514 *g–m*, 578, 896 902 *i–m*).

SIXTH DIVISION OF PHYSIOLOGY.

THE RELATION OF ORGANIC BEINGS TO EXTERNAL OBJECTS.

626, *a*. That division of physiology which concerns the relations between living beings and external nature is very comprehensive, and brings into immediate connection the three great departments of medicine; and it is an object of these Institutes to consider the subject under this limited aspect. Here it is that these several branches meet together, and here it is that we learn that pathology and therapeutics are only modified aspects of physiology. They are all immediately interested about the properties of life; physiology regarding the healthy influences of external agents upon those properties, pathology their morbific effects, and therapeutics those changes which are exerted upon the morbid properties by remedial agents. A common principle is, therefore, concerned throughout. All the diversified results, whether physical, or vital, are directly dependent upon the existing condition of those properties. That condition is ascertained, in all its mutations, by the resulting phenomena.

626, *b*. Upon this ground, also, as upon that of the more internal economy, may be utterly exploded all the chemical and physical hypotheses of life and disease; since, were any of those doctrines founded in truth, the action of external causes should be directly upon the composition and structure. And so should the blood itself upon the sanguiferous system, urine upon the bladder, bile upon the intestine, &c.

The moment we begin the study of effects as manifested by living beings, whether induced by internal or external causes, or those which arise from the action of living beings upon outward objects, we find ourselves surrounded by an endless variety of phenomena which denote the existence of a formative principle, upon which all the impressions are made, and which is the primary cause of all that are made upon external bodies,—which moves the body from one place to another, exerts all the changes that are effected in food, elaborates that, and that only, from the universal mass which is suitable for the formation of blood, which governs all the processes of organization, which is susceptible of alterations in its condition in consequence of the action upon it of many external objects, which is liable to analogous influences, healthy and morbid, from the operations of the mind and its passions, and which possesses an inherent tendency to return from a morbid to its natural state, the essential cause of preservation. Surrender these doctrines, and all our reasoning about organic beings, all our physiological and medical philosophy, would be a mere jargon of words. Hence it may be always seen, that those philosophers who deny the existence of a principle of life, or substitute the chemical forces, are driven to the necessity of speaking and writing as if allowing its full operation the moment they concern themselves about the phenomena of life. They must have, and they know it, a peculiar cause for effects so peculiar as those of organic beings.

627. In my examination of the constitution of the different tissues,

and of the properties and functions of life, the topics embraced within the present division of Physiology came, unavoidably, under analysis; and have been variously reproduced when investigating the laws of vital habit, the influences of age, temperament, climate, &c. But little, therefore, remains to be added.

628. In regarding our relations to external objects we should carefully discriminate between irritability and sensibility, the two properties through which the relations are established; the former connecting organic life, the latter animal life, with the external world (§ 188, &c., 194, &c.). Vegetables, therefore, hold their connection through irritability alone; so that their organization is intimately associated with outward objects. The connecting anatomical structure in the organic life of animals consists of the alimentary canal, the lungs, and the skin; in plants, of the radicles and leaves (§ 268, &c.).

630, *a*. In organic life, as has been already seen, agents of all kinds operate through the medium of irritability (§ 188). Their effect depends upon the *degree*, and the *kind* of irritability, and upon the *kind*, *energy*, and *quantity* of the agents (§ 133, &c.). Owing to changes in the degree of irritability the same stimulus or sedative, and in the same quantity, does not always produce the same amount of effect. It will be more, or less, on one day than on another, even at one hour than another. This is constantly exemplified in the natural states of the body, but distinctly in disease, when irritability is also modified in *kind* as well as in degree. The law is of great importance in medicine, and is subject to many contingent influences, both in health and disease, especially that of vital habit. These influences involve some of the most difficult and delicate considerations in the practice of medicine, and more so from nervous complications.

630, *b*. Again, the alterations of irritability in morbid states, whether in degree or kind, will depend upon the virtues of the morbific agent, and upon the natural modification of the vital properties in any particular part. This combined condition, and according to its nature, requires particular adaptations of remedies, whose operation, also, will be in conformity with their own virtues, and with the natural and acquired conditions of the organic properties (§ 150, &c.). The principle is, also, equally true of all diseases in their development of sympathetic affections.

630, *c*. From what has been said of the natural modifications of the vital properties in different parts, and of the specific relation of natural and remedial agents to those various conditions, it is obvious that the same morbific agent will affect one organ more or less differently from what it will another part (§ 133, &c.). Cantharides will not offend the stomach, but will excite inflammation of the bladder, and of no other part, in its proper therapeutical doses. And just so, though less remarkably, of the ordinary causes of disease. Cold and dampness constantly excite inflammation of the mucous coat of the nose, trachea, and lungs, while they far more rarely affect other parts. One poison strikes at the brain, another at the liver, and another at the skin, though their primary action may be often exerted upon the stomach. Other directions, however, may be given to each of these morbific causes when they are brought to act upon parts which are already diverted from their natural states, and will be liable to other variations from the numerous accidental influences by which every

individual is surrounded. It is these fluctuating influences which render measles, scarlet fever, the intermittent and yellow fevers, typhus, &c., more malignant at one time than at another, or more violent in one person than another. The same law obtains even in respect to idiosyncrasy, as in those subjects who are not affected by the poison of the rhus, &c. (§ 585, *b*). The differences result mainly from different modifications of irritability, and corresponding influences of various causes, not from "absorption and elective affinity."

630, *d*. As all morbific agents differ in their *kind*, so are the effects of all more or less different from each other. Each one, or according to their combined influences, other circumstances being equal, affects the organic states in one uniform way; and this is as true of the malaria which generate typhus and yellow fever, the plague, &c., as of the virus of small-pox, measles, hydrophobia, &c. The differences in results will, of course, be most strongly pronounced when the morbific causes differ most from each other.

630, *e*. Many important practical considerations grow out of the principles involved in this section (§ 630), and which will come up for general remark under the remote causes of disease (§ 644, &c.). As an illustration, in greater detail, of a single element of this complex subject, let us now analyze the compounded influences which impart to measles, scarlatina, &c., their epidemic character, and their greater complexities when thus distinguished than in their sporadic form; and it will be seen, also, that the same principles are of extensive application to individual cases of all forms of disease, whatever be the nature of the compounded causes. Take, in the first place, epidemic fevers, epidemic dysentery, epidemic bilious pneumonia, &c. Here the causes may be mainly some special miasmata of intensely morbific properties, though more or less aided by the use of stimulants and stimulating food, &c., operating as predisposing causes subordinate to the miasmatic or essential cause (§ 648 *c*, 650–659, 662–663, 666, 870 *aa*). Coming to the contagious diseases, each malady has a more clearly defined predisposing cause, which is always generated by the special morbid states of these diseases respectively (§ 653). But in these affections when occurring epidemically, and sometimes in their sporadic forms, the miasmata that are indispensable to fevers contribute their malign influences in rendering the system more susceptible to the morbific effects of the contagious principle, increase the intensity of its operation, and lay the foundation of those local congestions of the abdominal organs which are attendant on epidemic fever, epidemic bilious pneumonia, &c. (§ 961–970, 1002–1005), just as stimulants and stimulating food operate in these miasmatic diseases. The same philosophy is applicable to the malignant cholera, which has for its indispensable cause some specific atmospheric virus, but often greatly promoted in its morbific effects by the predisposing causes of miasmatic fevers, and which concur in instituting the local congestions that are incident to those fevers (§ 654 *a*). The principle is the same, also, with those diseases where a predisposition to some specific form is impressed upon the constitution, as in scrofula, rheumatism, lues, &c. (§ 72–73, 75–79), and which modifies, or is modified by, the miasmatic influences that generate fevers (§ 652 *b*, 660–662, 858). Superficial diseases, such as "putrid sore throat," erysipelas, &c., often spring from profound abdominal congestions, and are apt to be fatally mistaken for simply local affections (§ 689 *l*, 961 *a*, 970 *c*).—Note Oo p. 1141.

SEVENTH DIVISION OF PHYSIOLOGY.

DEATH.

631. Organic beings die; nothing else. What is it, then, that dies; and why, in consequence, do living beings return to the mineral kingdom? The functions, it is answered by many philosophers. But the functions are merely results. It is their causes, then, that perish. And what are the causes? The chemical philosophers answer, the forces which are capable of so many results in the inorganic world,—the chemical forces. But the facts contradict that philosophy; for no sooner is the organic being dead, than we witness an exactly opposite series of results as the effects of chemical changes. We witness, I say, a demonstration of chemical results beyond any other example in the natural world, and it is then only that we witness them at all. The causes which are withdrawn must have been as peculiar as the universal phenomena that have disappeared, and as opposite to those chemical forces which take possession as their power of resisting them during life is unquestionable. These causes have been called the vital properties, which, like the powers or properties of the mind, are elements of one principle, which is known by the name of the vital principle. It is the extinction of this substantive principle which essentially constitutes death, as its existence essentially constitutes life. Those who deny its existence are generally, also, materialists in respect to the soul, if they be not chargeable with a greater vice.

632, *a*. The tendency to death, in man alone, having been introduced since his creation, the properties of life must have undergone some miraculous change. Man was created imperishable. By sin came man's death, by perseverance in sin, a farther abbreviation of life. We must admit this doctrine of Holy Writ, and apply it philosophically. We may not reason as to the Order of Providence, had the material man been immortal. Doubtless, ample "room" would have been provided for his indefinite multiplication, at least in the ultimate abode of the translated Prophet.

632, *b*. But, assuming that life has been shortened from a thousand years to "three-score and ten" by the agency of physical causes, there must have been a miraculous change in the condition of the inorganic world, since it has been without change, in its relations to disease, up to the earliest records; but the very face of the earth assures us that there has been neither a natural nor a supernatural change in the condition of matter, or in the laws of inorganic nature. We are therefore compelled to take the Revelation of Heaven as it stands; or, in denying one part, to deny, also, the longevity of primeval man; which will obliterate all common ground between the disputants.—Notes C p. 1113, Pp p. 1142, Qq p. 1145.

633. Life does not generally reach what may be called its natural termination. We have already seen that its natural extinction is the work of its own progressive movements; that it is the result of the same creative operations that developed the ovum into the new-born offspring,—that continued the same process through the various stages of life up to the time of full maturity,—that still went on with the

work of superaddition, till at last, by the progressive condensation of organs, by clogging the sanguiferous system with interstitial deposits of bony matter, &c., it loses its control over its own instruments of action, and fails for want of means to carry on its productive operations. It is not, therefore, from any natural failure of the properties of life, or any "wearing out of the machinery," as is commonly supposed, that life ultimately becomes extinct, but from the prolongation of that process by which it laid the substratum for those active operations, which, when once begun, must be continued in uninterrupted progress along with the original creative function (§ 63–82, 123, 170 *c*, 175 *b*, 176, 237, 584). This ultimate effect, as well, also, as the exposure of life to the influence of morbific causes, is a striking exemplification of the Order of Providence in carrying out His final purposes in the natural world, where the general plan has been miraculously diverted from its original design (§ 632, *b*).

634. The principal elements in the production of death may be found in the modes by which it may be suddenly effected. 1st. By the failure of the circulation, as in syncope. 2d. By the failure of respiration. 3d. By sudden and pernicious determinations of the nervous power upon the circulatory and other important organs. 4th. By the same determination of the nervous power upon the organic properties of the brain, as seen in instant death from apoplexy, anger, joy, surgical operations, blows on the stomach, &c., though, in these cases, there is also a pernicious nervous influence propagated to the heart, &c. (§ 230, 510, 511). Death from syncope is immediately owing to the failure of the heart to supply other parts with blood; though the nervous power is especially instrumental in prostrating the organs of circulation (§ 940–942, 947–949). Death from abolition of the respiratory function is owing especially to a consequent failure of the decarbonization of the blood. It is remarkable how speedily a loss of con sciousness, and, of course, of all sensation, is sustained by the suspension of this function; and it may be of interest to some to know the facts as lately experienced in my own person. Being precipitated into a stream of water by the upsetting of a stage (my head through the window of the carriage), and perfectly conscious when first beneath the water, the reflections which occupied my mind could not have continued one minute. There remains the most distinct recollection of that brief period. The subsequent details, till consciousness was restored may not be without an interest. My momentary efforts at extrication were defeated by the weight of the passengers, and I continued to occupy the foregoing position till nine of them, and mostly females, could be lifted through the uppermost door, and while the carriage, heavily laden with baggage, could be rolled over. This process consumed at least some seven or eight minutes, and three or four more had elapsed after my extrication before signs of reanimation began to take place.* A large assemblage of farmers from the neighboring fields were standing around, when the first moment of consciousness was announced by a noise as of distant speakers, and a simultaneous view of the spectators. Vision was at once perfect; but the sounds advanced progressively nearer and nearer, and within a quarter of a minute had identified themselves with their proper sources; when, also, consciousness was completely re-established. It may be also worth saying, that only a very slight uneasiness attended the suffocation.

* I have been since informed that the interval was more than twenty minutes. Nothing was done toward reanimation.

635. Nothing extinguishes life more immediately than a destruction of all the functions of the brain, whether by a direct injury of the organ, or by an abolition of the circulation. The effect is nearly as great when interrupting the respiratory process by dividing the medulla oblongata. But in this case the influences are different from such as obtain in diseases of the brain, or in injuries done to that organ. If sufficient to embarrass or to suspend respiration, the nervous power is determined with a pernicious effect upon all the organic viscera; but very variously, according to the nature of the injury or of the disease (§ 478–482, 510, 634, 948). A simple removal of the brain and spinal cord occasions death not only by suspending respiration, but by interrupting their influence upon the great organs of life; which must be also true within greater limits of the division below the medulla oblongata. In the former case, as we have seen, no pernicious influence of the nervous power is determined upon the organic viscera; in the latter, a direct violence being inflicted upon the spinal cord, a destructive effect is propagated upon the organic properties, which reaches to the brain itself (§ 129, 455, 456, 476½ *h*, 478, 479, 489, 507, 1032 *d*, 1037).

636. Death from disease generally depends upon complicated causes, and upon profound affections of more organs than one. In a general sense, also, the particular mode of death will depend upon the organs diseased, upon the violence and kind of affection, and upon the particular condition of other parts.

637. It is rare that absolute death takes place at once in all parts. Evidences of this are seen in the peristaltic movements, in the contraction of the voluntary muscles, in the discharge of the arterial blood into the venous system, in the occasional exaltation of heat, &c., after apparent death (§ 447, *d*). We have seen, also, how remarkably the heart may be roused into action long after its pulsations have ceased (§ 262, 498 *e*, 516 *d*, no. 7), continuing, in some animals, to pulsate with a "rustling noise for ten hours after being hung up to dry" (*Med. and Physiolog. Comm.*, vol. i., p. 17). In other instances, the heart has been "often seen to raise a weight of twenty pounds," soon after apparent death; and Lord Bacon states that he has seen the heart of a criminal, when the organ was thrown into a fire, leap up one foot and a half, and to continue these movements, with a gradual decrease, for the space of seven or eight minutes (§ 188, 233, 264, 265, 475½, 498 *e*, 647½). In my work on the *Cholera Asphyxia of New York*, 1832, I have spoken of contractions of the voluntary muscles which continued in progress, drawing up the legs, &c., for an hour and a half after apparent death (p. 141). These contractions took place without the application of any exciting cause, apparently like the movements of the extirpated heart and intestine (§ 262, 476½ *c*, 490, 498 *e*); but the latter are due to the stimulus of the air or other physical causes. There remains, therefore, no other conceivable exciting cause of the contractions than the stimulus of the nervous power arising from influences incident to the radical change in the organic constitution, analogous to that development which is attendant on syncope, and which in this case, besides its powerful demonstration upon organic actions, often induces spasm of the voluntary muscles (§ 948). The analogies in this respect, and such as are represented in section 500, are strongly in favor of reflex nervous action, while the corres-

ponding action of the extirpated heart and intestine may seem to be opposed to it. The analysis, also, of sympathy which I have made in preceding sections (500, &c.) shows a special difference in the motive constitution of the organic viscera and of the voluntary muscles, and in the relative agency of the nervous power as it respects their motions. In the former case this power is particularly a modifying agent in organic actions; in the latter it is simply an exciting cause (§ 188, 205, 215, 222, &c., 258, 500, 524 *d*, no. 7, 891½ *g*, *k*, 893½).

If the foregoing construction be true, then the muscular contractions which follow, after apparent death, from blows upon the limbs, are equally due to the development and action of the nervous power (§ 516 *d*, nos. 8, 9); and the whole conclusion is farther strengthened by the involuntary movements of decapitated animals, and by the muscular contractions which are effected by the stimulus of galvanism, both in life and apparent death, and especially when consequent on pricking the skin after removal of the head. The latter case, indeed, is exactly analogous to motions produced in the limbs of the human subject by mechanical violence; since in the case of the decapitated animal there is no direct irritation of the muscles, and, therefore, no possible mode of propagating the impression upon the skin to the muscles, excepting by reflex nervous action. All this, too, shows us that, whatever differences may exist between the vital constitution of man and animals, and among animals, they are essentially constituted alike, subject to the same fundamental laws, and having only modifications ingrafted upon them.—Note A p. 1111.

It may be thought that all this is a useless refinement in philosophy. But such is not my opinion; nor have I any doubt that better minds will carry out these suggestions to more important developments in the philosophy of life. Even in death itself much may be gained that will be useful in physiology; and if we follow the organic being till he is resolved into elementary substances, we shall gather something at every stage of the process that will contribute light to organic science, and yield an interest to the study of putrefaction (§ 54 *a*, 56, 62 *e*).

SUMMARY CONCLUSION OF PHYSIOLOGY.

638. From what has been hitherto said, it appears that medicine, in all its branches, is a perfect whole, bound together by intimate relations and dependences, nowhere contradictory, but all in unison, and irresistibly flowing from one great system of Unity of Design, which is the grand characteristic. The foundation is laid in the *Principle of Life, and its various attributes.* The demonstrations of that principle, and of those attributes, begin with the elements of organic beings, their number, the modes in which they are united, &c.; and the sameness of the principle throughout, and the coincidences in its laws, are attested by every fact in physiology and medical philosophy.

By recurring to the demonstrations already set forth, it will be seen that my fundamental ground is clearly established; for, whether it be the elements of organic beings which are combined in peculiar numbers, proportions, and modes, and forever in one peculiar and exact manner in every distinct part of every organic being, and which are maintained in combination against the adversities of disease, and against those chemical agencies which may produce their almost instant dissolution when the vital chain is severed; and whether we consider, also, the remarkable nature of those elements, and that in the animal kingdom, especially, nitrogen gas abounds in the various tissues, notwithstanding the entire kingdom is far more liable, than the vegetable, to chemical decomposition after death; or, whether we pause at the threshold of life, and consider all the unvarying facts attendant on the development of the ovum, how one part after another springs into existence in a never-deviating, foreordained manner, and as each part may be necessary to the next succeeding, how the same exact process of formation, and no other, is continued till the being becomes again a subject for the mineral kingdom; how the semen, also, is a type of all the various subsequent agents of life; how we may here detect the nascent causes of transmitted disease, operating in conformity with those which play their part in the external world; how mind itself is impressed upon the embryo, and how the intellectual peculiarities of either parent may be ingrafted upon the offspring, as are their physical traits, their temperament, their constitution, their very manners,—where, I say, all is uniformity in the grand movement of organization, and nothing but coincidences in the fluctuations that may arise from preternatural causes, and always the same according to the precise nature of those causes; or, if we follow the immature being to its state of maturity, and observe that the progress of development is always the same, under equal circumstances, at every stage of its progress, whether in the animal or the plant, and notice, also, the coincidences which obtain between the two organic kingdoms, as in the changes of tissues, in the variations of products, up to the consummation of the whole in that perfect state which is characterized by the development of the generative organs, the flower, the ovum, the seed, and the mutual office of sexual intercourse; or, whether it be a corresponding exact organization and vital endowment of every part of every organic being, yet different in every organ, and often so in different parts of one and the same continuous tissue as it traverses

different parts of the compound organism; or, whether we regard the products of each organ, or of each tissue, or of the several parts of a continuous tissue, respectively, and observe that they are forever the same in the same animal or plant, under equal circumstances, yet different in every part, and more or less different from each other in every species, whatever the similitude, or consider that the same products are forever modified in health and in disease in one exact manner, under any given modifying influences, whether natural, morbific, or remedial; or, whether we interrogate the nature of the relations by which external or internal causes divert the phenomena from their natural states, and observe that the results depend upon the exact original and acquired nature of the part and the nature of the influences, and that they are in perfect harmony with such as emanate from the natural stimuli of life; or, whether we consider how the manifestations of disease denote, like those which emanate from the natural stimuli of life, an established difference in the closely-allied constitution of the same or different tissues, and different parts of a continuous tissue, as in the inflammatory affections of various parts of the mucous, or the serous tissues, and the more remarkable peculiarities attending the inflammations of the lining membrane of the veins, —prostrating the circulation and giving to fever its malignancy; or, whether it be a small current of air impinging upon the neck, which will suddenly induce an attack of catarrh, or of pneumonia, or of rheumatism, when no such effect may follow an equal exposure of any other part of the surface, or even of the entire skin for an equal time; or whether, in a remedial aspect, leeches, or a warm bath applied to the feet, may restore menstruation when the same applications to other parts might be insufficient, or other analogous phenomena which abound in the history of morbific and remedial agents; or, if we consider the philosophy which concerns the first act of inspiration as generated by the contact of air with the surface of the body, and that it is exactly the same as that which is relative to the first inspiration in syncope when cold water or cold air are applied to the face, or stimulants to the Schneiderian membrane, and even the same when the mucous tissue of the lungs becomes the point of departure,—the same, too, which concerns all those modifications of respiration which are known as coughing, laughing, crying, sneezing, hiccough,—the same as obtains when light, impinging upon the retina, produces either a contraction of the iris or a paroxysm of sneezing,—the same as when a leaf of tobacco applied to the sole of the foot may disturb every function of the body,—the same when cathartics, or emetics, or alteratives, &c., may send their influences abroad through the medium of the gastro-intestinal mucous membrane,—the same when shame mounts to the face, or fear expels the blood from the surface, or covers it with moisture, or stimulates both kidneys and bladder, or as anger convulses the heart and braces up the animal muscles,—the same, in principle, whether one or the other be applied in a physiological, pathological, or therapeutical sense; or, whether we regard the organism as a whole, and consider how all parts concur in harmony together; how numerous parts are supplied by natural stimuli, consisting of blood or of products from it, which conspire together in maintaining the good of the whole, but either of which would be offensive to other parts, and disturb the harmony of the whole; or how the nervous

power sheds its regulating influence upon all parts of the animal mechanism, and how, through that same power, from its natural susceptibility to the existing healthy state of every organ, both external and internal causes may lay the foundation of disease, or effect its removal, or occasion the most violent commotions, or extinguish life in a moment; or, whether we consider that the same relative facts prevail in respect to the vital signs that distinguish the physical products, and that they go hand in hand together, under the same established or contingent influences, natural, morbific, or remedial; or, whether we scrutinize the coincidences between the facts that are relative to the changes that happen at the different eras of life, and to gestation, lactation, &c., and such as are brought about by morbific and remedial agents, and consider that the latter are a necessary consequence of the natural mutability of the fundamental constitution from which the former emanate; and that those which are natural are an exact type of the influences and their mode of production when morbific or remedial agents operate upon distant parts by impressions exerted upon the stomach or skin, or when disease of one organ gives rise to disease in another; or, whether we regard the corresponding facts which are relative to vital habit, or those which result from the influences of climate, &c., and which bestow the radical modifications that form the peculiarities of temperament, &c., and see, also, that all these variations are produced by causes that operate through the same fundamental constitution; or, whether our hygienic and therapeutical treatment may be greatly regulated by each of the foregoing conditions, whether natural or acquired; or, whether it be the peculiarities of idiosyncrasy that render certain ordinary articles of food morbific to certain individuals, or the analogous constitution of marine and terrestrial plants which demands for the former the briny waters of the ocean, while they are fatal to the latter; or, whether, in like way, the mere approach within ten feet of the poison rhus will produce a violent erysipelatous imflammation over the whole surface of one person, when even the handling the plant will never affect another; or, whether the rolling of a few blue pills with the fingers will establish salivation, and affect the adult constitution of some, while a pound of calomel taken by the stomach will not affect others in a similar manner, and rarely at the early stages of life; or, whether it be bloodletting, or the mercurial or the antimonial alteratives, that are often baffled by the precise modifications of the specific forms of active inflammation, while they readily subdue the common form and many specific chronic inflammations, and whose differences in results denote the modifying influences of the remote causes of closely analogous affections; or, whether mercurial agents be strictly morbific in their action upon the salivary glands, while they are simultaneously and powerfully curative of hepatic and other diseases; or, whether a mercurial cathartic will induce salivation if the susceptibility of the system be increased by the associate use of other cathartics or by loss of blood, when, *per se*, no such effect may be produced; or, whether the same effect follow the mitigation of fever, when no extent of the remedy may reach the constitution in high grades of febrile action; or, whether the bite of the mad dog will produce hydrophobia in all mammalia, while the disease cannot be imparted by any other than the canine and feline tribes; or, whether the poison of the rat-

tle-snake, or of the wourari tree, or numerous other poisons which are certainly and rapidly fatal when inserted beneath the skin, be perfectly innoxious when taken into the stomach or applied to the surface of the brain; or, whether it be the virus of the small-pox, of measles, &c., that effects certain modifications of the vital states relative to each particular agent, and to no other, that forever protect the system, in a general sense, against a second attack; or, whether it be the cow alone, as with other animals in respect to the virus of hydrophobia, that can so modify the variolous poison as to generate in man the equally protective vaccine disease; or, whether the susceptibility sometimes remain so as to give rise to another modification, while the varioloid, in its mildest state, but not the vaccine, will generate, by contagion, in the unprotected, the most virulent form of the original disease; or, whether it be the analogous miasmata that only slowly extinguish the susceptibility to their morbific effects after repeated attacks of the particular forms of fever which they are, respectively, capable of producing, or, if the subject thus acclimated remove to another region, his original susceptibility may return,—being analogous, also, to those physical agencies which establish the temperaments, and which change from one to another as the old influences may cease, and new ones operate, while analogies, in these respects, are also supplied by the variolous and vaccine diseases; or, whether it be bloodletting, or an emetic, or a cathartic, that produce their alterative effects with a rapidity proportioned to the rapidity in which their sensible operation goes on; or, whether it be the alterative in small doses, and in its abstract sense, that slowly establishes analogous changes in the morbid states; or, whether an alterative, as antimony, for example, must be generally increased in its successive doses to keep up the effect of the first dose, or, if there be, in respect to antimony, a suspension of the remedy for at least twelve hours, we must then go back to the original smaller quantity to avoid an excessive effect; or, whether, on the other hand, other alteratives, like mercury, or foxglove, or cantharides, or arsenic, or quinine, or ipecacuanha, will manifest no sign of their influence for several successive doses, but will, at last, without any increase of the dose, suddenly display the full effect of their virtues; or, whether by associating ipecacuanha with the sulphate of zinc, the latter will so exalt the susceptibility of the stomach that the two agents, otherwise unequal in time, will simultaneously co-operate in their emetic effects or whether, in the same way, a diffusible stimulant, associated with a permanent tonic, will quicken greatly the action of the latter; or whether, in like manner, and like the virus of small-pox, of measles, &c., or like the miasmata, it be opium, or hyoscyamus, or digitalis, or mercury, &c., that reduce or increase the susceptibility of the stomach and of the general system in relation to the virtues of each agent, respectively, but to those of no other; or, whether we consider other examples of vital habit, and observe how pungent stimuli cease to annoy the nose, the mouth, the stomach, &c., but only so in relation to each of the agents, respectively, or how tobacco, which is morbific in most diseases, and originally offensive to all, finally becomes the most universal luxury of man; or whether we consider the manner in which the alteratives, in there small and oft-repeated doses, maintain their influence, and extend their silent

invasions upon disease, or how emetics, or cathartics, continue to propagate their curative effects after their complete expulsion from the body, and see that the principle is disclosed by the natural phenomenon of the permanent contraction of the sphincter muscles, which, although the urine or the contents of the rectum be evacuated, are maintained in equal contraction by the irritation which remains upon the mucous tissue, and through which the nervous power is uninterruptedly reflected upon the sphincter muscles; or whether we regard the coincidence between respiration, spasmodic affections, and the voluntary movements of the respiratory, or of other muscles, and observe that each is alike due to the propagation of the nervous power upon those muscles; or whether we contemplate the same vital agent in its production or removal of disease, and in its absolute mode of operation, and see that the changes which are thus effected consist in some alteration of the natural or morbid states, and according to the nature of the remote cause, whether it be positive, like mercury, or negative, like cold, or immaterial, like the mind and its passions, and according, also, to the special exercise of one mental power or another, or the operation of one passion or another, and thus proving the susceptibility of the nervous power to various modifications that coincide with the virtues of the remote cause, and a coincidence, in this respect, with the changes which are perpetually exhibited in the organic vital conditions, and which are even brought about by the nervous power itself; or, whether we realize the foundation of these last phenomena in the naturally exquisite susceptibility of the nervous power to various influences, that it may constantly operate as a regulator of the rhythmic movements of all parts, and through a law of the nervous system by which all parts are exquisitely sensitive to the condition of each other, and through which all remote morbific and remedial influences are exerted; or whether, in like way, inflammations are varied in their character by contused, and punctured, and incised wounds, or more greatly so by all animal and vegetable poisons, whether morbid or natural, and mostly so according to the special nature of the remote causes, respectively, or, if subordinate influences diversify the effects of many principal causes, there be others which control all other influences, as in small-pox, measles, scarlatina, &c.; or whether in fever, as in inflammation, there be analogous varieties, corresponding, in like manner, with the special virtues of each cause, while the fundamental pathology is of one common nature in all the varieties of inflammation, and of another common nature in all fevers; or whether an ephemera be the type of the intermittent, the remittent, and continued fevers, and of their several modifications, and consider how the paroxysms of the intermittent commonly observe established intervals of twenty-four, forty-eight, and seventy-two hours, or, if the usual time be anticipated or delayed, the paroxysms are then apt to go on with the particular irregularity with which they began, or when, by regular anticipations of the period of each last preceding paroxysm they approach the night, one paroxysm is often lost; or whether we look at the effects of all our best and most universally remedial agents, as bloodletting, mercury, antimonials, cathartics, &c., and see that they are strictly morbific to the healthy system, in their remedial doses, and that, therefore, they are at least equally so in their action upon diseased organs, yet contributing to their cure; and while, also, we

know that neither such nor other agents can, of themselves, transmute the morbid organic changes to those conditions which are natural to the being, we yet discern the reasons of their favorable effects in the spontaneous and successful efforts of unaided nature, and in those speedy recoveries from morbid states that are induced in the healthy system by remedial agents, in their remedial doses, and thus infer that remedies only contribute to the cure of all diseases by instituting morbid changes that are more conducive to the naturally recuperative process; or, whether the cure of intermittents be effected by bark, or arsenic, or cobweb, or opium, or an emetic, or bloodletting, or abstinence, or by an emotion of the mind, &c.; or whether it be stimulants or sedatives, bark or bloodletting, conjointly or separately, that may subdue many inflammations, acute or chronic, and thus, also, prove the near identity of the pathological state in all the varieties, and that nature recognizes no such opposite conditions as *active* and *passive* inflammation; or whether it be the abrupt removal of pertussis by an hour's exposure to the open air where all other means had failed, or the improvement of an ulcerated limb by the same temporary influence; or whether ice, or ipecacuanha, or common salt, or opium, or bloodletting, or the sulphates of zinc, and of copper, or catechu, or kino, &c., will alike arrest capillary hemorrhage or redundant secretions, by modifying the action of the capillary vessels; or whether loss of blood, and tartarized antimony, or a dash of cold water upon the surface of the body, or even a warm bath, be far better "*refrigerants*" than pounds of ice, or of lemonade, taken into the stomach; or whether, among the "*sudorifics*," the drinking of hot water, of mint-teas, &c., will excite a more immediate and more profuse perspiration than tartarized antimony, or ipecacuanha, &c., and the former exert no other apparent effect, while the latter may be profoundly curative or morbific, or bloodletting surpass the whole in all these respects; or whether it be the "sialogogue," like horse-radish, which only exerts an effect on the salivary glands through a continuous irritation along the salivary ducts, or mercury, which induces salivation only by constitutional influences; or, whether we turn our attention to other corresponding laws, and to other analogous coincidences, and consider, for example, how all but chyme is prevented from passing the pyloric orifice, how all but the air is excluded from the lungs, how all but chyle from the lacteals, how all but white blood from the serous vessels of the arterial system, notwithstanding the far greater diameters of some than those of the red globules, and yet that when the irritability of one is morbidly affected, as in indigestion, solid food will pass out of the stomach; or of another, as when certain morbid impressions are made upon the lacteals, the deleterious agents may obtain a sparing admission; or of another, as in inflammation, the red globules are allowed to pass freely in; or, if we glance at those more astonishing phenomena which attend the generation of animal heat, and observe that all non-hibernating mammalia maintain one uniform temperature, under all circumstances of food, clothing, &c., whether at the poles or at the equator, yet each species, respectively, possessing a temperature of its own, and that the very giant of the mammiferous tribe, in the midst of everlasting icebergs, obeys this law of uniform and exalted heat,—exalted not less than four degrees above that of man; or turn our admiring contemplation to the few exceptions that occur in the hi-

pernating group, and see how that temperature, which is equally uniform under all torrid and temperate degrees of the circumambient air, sinks down as the thermometer descends from 40° F. till the animal scale reaches nearly the freezing point, and then rises, with a bound, to its original exalted standard, while the mercury goes on to the point of zero; or, if we drop from this gradation in analogy, to the cold-blooded race, and observe how they obey the physical law of an interchange of caloric with the surrounding medium, yet within the limitation of a specific and independent power of maintaining a counteracting influence that preserves them at a few degrees of heat above the lowest of the external medium which may be endured,—eating, digesting, and performing, too, the same organic functions as the mammalia; or, if we consider, also, the same peculiarities in the living egg, and their absence where its incubating property is extinct; or, if we turn ourselves to the vicissitudes of temperature which attend the phenomena of disease, and remark how they correspond with all the admitted vital changes,—rising, in one case, to a degree of intensity where there is almost a total privation of food, and an extensive destruction of the lungs, or sinking, in another, to an almost icy coldness, where the subject is plethoric and the stomach is crowded with food and alcoholic stimulants; or whether, also, we regard the same principle in its natural state, as seen in the process attending the reproduction of the stag's horn, or in that of lactation, and consider that here is the fundamental element implanted in the constitution for great and wise purposes, and that every other consideration points us directly to the natural constitution itself for an interpretation of every phenomenon in the history of animal temperature, and deduces a coincidence between these phenomena and those of the organic processes, under every aspect of stability, individuality, and of change; or whether it be a thousand other different, but analogous considerations, relative to the influences of foreign, natural, morbific, or remedial agents upon man or other organic beings; or whether we again look to the mind and its passions, and see the long exercise of judgment impairing digestion, while imagination comes in as a speedy restorative; or whether it be anger or joy, like a blow on the stomach, or like the shock of a surgical operation, that strike us dead in a moment, or grief that does but slowly undermine, or hope that throws its balmy influence over every disease, by whatever cause produced;—whether, I say, it be one or the other of the considerations now mentioned, or thousands of thousands of similar import, which crowd the history of living objects, each and all are in harmony with each other, and concur together in one universal demonstration of the peculiar constitution of animated beings as distinguished from the inorganic kingdom, and declare their essential dependence upon one principle, namely, a Vital Principle, *of various elements or properties*, whose definite character in their natural conditions, and whose instability or liability to permanent and temporary modifications and changes, and whose disposition to return from such as are only temporary to their original state, lie at the foundation of all the phenomena, will explain every phenomenon, and whose unity as a whole is supported by every phenomenon of organic beings. This consideration, therefore, assures us that we have already compassed the general philosophy of life, of disease, and of medicine; and we contemplate with admiration the sim-

plicity, yet complexity, of the principles, the stupendous whole, as it swells from the comparatively simple phenomena of the development of the ovum, when the properties of life are exposed to no influences that shall affect their instable nature, till we have traversed the animal kingdom in all its exposures to those influences, and have witnessed the incalculable variety of change which the organic properties and functions sustain in consequence of those exposures, and observe that the whole immense system, all the variety, springs from the simple influences of external and internal causes upon the properties of life, and that slight changes in these properties, like the differences which prevail among the results of their natural modifications in different animals, and in different parts of a common or a continuous tissue, give rise to all the differences between health, disease, and convalescence;—in the contemplation of all these things, I say, we are employed in witnessing the most comprehensive and sublime system of UNITY OF DESIGN, and enjoy the conviction that we are cultivating a science whose foundations are laid in the most CONSUMMATE WISDOM (§ 1085).—NOTE RR p. 1145.

REVIEW OF THE LAWS OF REFLEX ACTION OF THE NERVOUS SYSTEM, AND AS APPLIED PATHOLOGICALLY AND THERAPEUTICALLY.

638½. A large space has been given to the consideration of the nervous system, especially to experimental observations upon it, for the purpose of developing the *Laws of Reflex Nervous Action*, or, as I have called them, also, for obvious advantages, *Remote* and *Contiguous Sympathy*, or, indifferently, *Sympathy*. All this inquiry has been made with a sole reference to the application of those laws to many important problems in *Physiology*, particularly nutrition, secretion, modifications of structural development, calorification, and circulation, and to erecting upon them a substantial and philosophical fabric of Pathology and Therapeutics, which still lies extensively before us, and for the purpose, also, of simultaneously accomplishing the overthrow of the chemical and physical doctrines now prevailing in all the departments of medicine. Although I am about to enter upon the specific application of the *Laws of Reflex Action of the Nervous System* to Pathology and Therapeutics, I have, nevertheless, been constantly employed in exemplifying the morbific and therapeutical aspects of those laws as founded upon their natural conditions. An indispensable requisite for this application is a reasonable proof of the modification of the nervous power according to the nature of the cause, whether physical or moral, by which it is brought into preternatural operation, nor is there any other consistent or intelligible mode of interpreting the great range of pathological and therapeutical problems, and the multifarious displays of the passions in organic life, according to their individual nature. The whole of the Author's philosophy upon this vast subject is predicated of the well-established laws of reflex action of the nervous system, nor is he aware of any fact by which that philosophy is contradicted, while, besides the admitted premises, it is sustained by the whole history of morbific and remedial agents, and by the diseases which grow out of, and are maintained by, each other. It may be finally added, that, although the Author has shown that the passions, the will, cerebral diseases, and other causes acting directly upon the nervous centres, develop and project the nervous power without the intervention of sensitive nerves, he has also shown that the essential philosophy is the same as that which respects reflex nervous action (§ 453).

PATHOLOGY.

639, *a*. HAVING now laid a broad foundation for the superstructure of pathology and therapeutics, in the exposition of the properties, the functions, and the laws of organic beings in their natural states, and in contrasting the philosophy of the more difficult problems with those interpretations which have been borrowed from the phenomena of the inorganic world, that nothing may obstruct our way, and that whatever is true in any of the conflicting views may shine with greater lustre, I am thus prepared to go on with those lofty objects about which the healing art is immediately interested. I say, to go on; for in all my physiological inquiries I have endeavored to indicate their relations to the ultimate branches of medicine, and to approach these branches already prepared with a connected view of their dependence upon natural institutions. The complexities in physiology give rise to corresponding intricacies in pathology and therapeutics, and it has been therefore necessary to explore the ground-work in such various methods, and with such variety of illustration, as shall impart to pathology and therapeutics a consistency in principles, a ready interpretation of their endless problems, and give to the hand of art enlightened confidence and firmness in the right. I have designed that this right shall follow naturally and easily from the premises hitherto laid down, and if I have come short of that, then have I failed in fundamental requisites. No system in physiology can stand which is not true to Nature in her altered aspects; none that does not come to her interpretation under all the varied conditions and phenomena of disease; none whose elements conflict with each other (§ 516 *d*, no. 6, 524 *a*, 524 *d*). There must be clearness, individuality, harmony, demonstration. I claim not that I have accomplished all this. I do but say that I have attempted it, and with an earnest hope that the effort may not prove abortive. As much has been said, and much remains, which is original with myself, and generally relative to the most profound and important topics, and, as there has existed the necessity of exhibiting in a satisfactory manner those conflicting errors which have obtained such general ascendency, I have been impelled to all the amplitude of inquiry which may obtain either the acquiescence of the profession in the doctrines which I have taught, or their ready rejection (§ 1, 285, 1067).—*See* RIGHTS OF AUTHORS, p. 912.

639, *b*. PATHOLOGY concerns the changes which the vital properties and functions undergo in disease, and the resulting changes in the vital and physical signs, and finally reaches to those lesions of organization that fall within the purview of morbid anatomy (§ 695, &c.).

Pathology consists essentially, therefore, of those modified states of the physiological conditions which constitute disease.

640. Such, also, are the relations between the natural physiological conditions and those diversions which make up disease that the latter often reflect the most important light upon the natural ones. The properties of life, in all their aspects, as well as their corresponding

functions, are not unfrequently best comprehended through the phenomena which distinguish their various departures from the normal standard (§ 198, 303⅔). Chemists, therefore, cannot be physiologists.

641. Pathology is divided into general and special. The first considers diseases in common; the second treats of the particular history of diseases. A distinction has been also made into medical and surgical pathology; but it is unfounded in nature, though it may be convenient in practice.

642, *a*. As all diseases have their remote causes, which often reflect much light upon pathological conditions, these should be embraced in the department of pathology.

642, *b*. The vital properties are so susceptible in their nature that the good, as well as the evils of life, is constantly inflicting disease. Whatever is salubrious in due proportions becomes morbific in excess. The mildest nutriment in excessive quantities, or at unseasonable times,—an unrestrained indulgence of the passions,—inordinate exercise, &c., prove the instability of the vital powers. We are also surrounded by agents of noxious virtues, some of which we may avoid, but covet as luxuries,—while others, if we would avoid, are beyond our control (§ 150, 152).

643. We are therefore led to consider pathology under three principal heads; namely,

I. Remote Causes of Disease.
II. Proximate or Pathological Causes.
III. Symptoms.

I. REMOTE CAUSES.

644. The remote causes of disease are the first in the series. By their deleterious action on the properties of life they give rise to those changes which constitute the proximate or pathological causes, or the essential conditions of disease (§ 188–192).

645, *a*. Remote causes are subdivided into *predisposing* and *exciting* or *occasional* causes.

645, *b*. The *predisposing* causes are the most important; being indispensable to all idiopathic fevers, and to all specific forms of disease.

645, *c*. The *exciting or occasional causes* are such as develop an attack of disease after the predisposing have laid the foundation. The latter, therefore, may produce their full impression, and the subject escape an attack, unless afterward exposed to the exciting causes. The predisposing, however, often operate with such intensity as to prove exciting, also; as in small-pox, measles, hydrophobia, poisons, injuries, malaria, &c. (§ 559). But the mildness, or intensity, of many of these affections, as in the contagious diseases, may depend upon the antecedent operation of other modifying causes; whether of a predisposing or protective nature (§ 630 *e*).

Again, the exciting cause often consists of something which, under ordinary circumstances, may be perfectly inoffensive; such as a full meal, a few glasses of wine, privation of sleep, anxiety, grief. In such cases there has always been an antecedent predisposing cause in operation; but either of the foregoing may operate both as predisposing and exciting causes.

646, *a*. Remote causes are either *internal* or *external*.

646, *b*. The *internal* consist, for example, of the passions, laborious

study, retention of the fæces, hereditary predispositions, &c. (§ 75–80, 144, 561).

646, *c*. The *external* consist, 1st. Of such as are ordinarily salutary, but become morbific by their excessive or too frequent use, or when used at undue seasons, or when the body is disqualified for their use. 2d. Such agents as injure mechanically the structure of our bodies. 3d. The great class of truly morbific agents, which embraces a large variety in the several departments of nature, comprehending, even, a large proportion of the *materia medica*, when exceeding the therapeutical doses, or when employed in these doses under circumstances of health (§ 177, 191 *b*, 237–240, 524 *d*, 854 *c–f*, 893, 900, 901, 905).

647. Among the most important of the internal remote causes of disease are morbid conditions already formed. They may be either exciting or predisposing, or operate as conjoint causes. In the former case other causes have brought about the predisposition. They are the great fountain of sympathetic developments.

647½. The nervous influence, *reflex* or *direct*, is the *immediate* remote cause (predisposing or exciting), of nearly all disordered states beyond the seat of the direct action of other causes (§ 222–233⅘).

648, *a*. The predisposing causes are *general* and *specific*.

648, *b*. The *general* are such as may be in simultaneous operation upon many individuals, and are, then, mostly connected with the atmosphere, giving rise to influenza, and other catarrhal affections, &c. Of these there are commonly several in combined operation; though there is generally one more important than the rest, especially in acute forms of disease.

They consist, also, of all those causes which give rise to the various forms of *common* inflammation, and all other conditions of disease which do not fall under the next subdivision.

648, *c*. The *specific* causes form a far more numerous class than the general. They consist of all the natural or healthy and morbid poisons, animal and vegetable, and the principal agents of the materia medica. Each of these will generally establish the predisposition by itself alone, and is generally the exciting as well as the predisposing cause. Among these causes must be ranked all those which generate idiopathic fever; and these being of vegetable origin must float in the atmosphere, and around the multitude. They are, therefore, the main causes of epidemics, properly so called (§ 650, 663). Such causes are generally aided in the development of disease by others which are simply exciting (§ 654, *a*).

648, *d*. The predisposing causes of sporadic diseases are apt to be more numerous than those of epidemics.

649, *a*. Remote external causes do not produce their effects indiscriminately on all parts to which they are applied. Some are perfectly inert upon the skin, while others exert their principal effects upon this organ. And so of other parts. The surfaces upon which they operate are, 1st. The mucous tissue; 2d. The skin; 3d. The surface of wounds and abraded parts; 4th. By being forced into the vessels when wounds are made by instruments charged with poisons. It is in the last two ways alone that many of the most active poisons produce their effects; such as the hydrophobic virus, the poison of serpents, the poison of dissection-wounds, &c.

649, *b*. Some parts of a continuous mucous tissue are more suscep-

tible than other parts of the same tissue (§ 133–137). And so of the skin. A current of cold air, for example, striking the neck more readily produces catarrh than when impinging on any other part; while its direct action upon the healthy mucous tissue of the lungs is never deleterious (§ 136). Menstruation is most readily suppressed by cold applied to the feet, &c.

The foregoing facts depend upon a principle of vast importance in every branch of medicine. Thus, in relation to the pulmonary intestinal mucous membrane, we learn from it, physiologically, that the generation of gastric juice, and the elaboration of carbon from the blood, are conducted by special vital processes, &c. (§ 135, 419), and this, with various other relative facts, such as the variety in effects of natural stimuli, goes to illustrate what is denoted by morbid phenomena of the special susceptibilities of different parts of a continuous tissue to the action of morbific causes, and how the same disease presents important varieties in the several parts; and, carrying these important considerations to therapeutics, we readily come to a distinct apprehension of the reason of the differences, local and constitutional, which spring from the action of the same remedy upon one part or another of that same tissue; as, for example, why tartarized antimony may relieve croup by its action upon the stomach, but may kill in the same case by an equal effect upon the intestine. And now, casting a glance at the universal body, we see the same law prevailing in other tissues, and among all parts which differ in organization. These combined circumstances open an immense field of philosophical and practical inquiry, and should forever employ the physician in a critical study of the therapeutical relations of the various articles of the materia medica to one part or another, in their local and sympathetic effects, and according to the precise pathological conditions of all the parts which are likely to feel the influence of the remedy, or as it may affect the more natural conditions of other parts, and, therefore, their favorable or unfavorable reflected sympathies (§ 129–152, 500, *nn*, 514 *h*, 638½).

649, *c*. There are probably but few ordinary morbific agents which affect the skin in its sound state, though some may which are not suspected. Cold is one of the most remarkable. There are but a few of the active poisons of the materia medica that affect either this organ sensibly, or other organs sympathetically through it. Mercury, tartarized antimony, and cantharides, are among the strongest examples of the action of remedial agents upon the skin, and through that organ upon remote parts. But, while blue pill, and the blue mercurial ointment, which are demonstrably not absorbed, produce inflammation of the salivary glands, and affect the system at large, after their application to the skin, they exert no more manifest effect upon the skin itself than when a cold current of air gives rise to pneumonia or rheumatism (§ 657 *a*). And since the foregoing preparations of mercury are no more absorbed than the cold air, it is evident that their direct action, like that of cold, must be exerted through the cuticle upon the susceptible properties of the skin (§ 514 *d*, 826 *c*, 1059, 1088 *b*).

Cantharides and tartarized antimony, on the contrary, affect the skin sensibly, and in a direct manner, and other parts, as in the foregoing case, by sympathy. But, tartarized antimony applied to the skin will not induce nausea, nor affect the constitution at large, whatever its

morbid susceptibilities, but only certain parts in the vicinity of its application, and then only when those parts are preternaturally susceptible (§ 143). It then operates, like blisters, through contiguous sympathy (§ 497, 1088 *b*). And so equally of croton oil (§ 893 *a*, 905).

When, however, almost any article of the materia medica is taken into the stomach it produces an obvious impression upon that organ, or upon the intestines. *Reflex* nervous influences are then transmitted to other parts; and it is upon this great law in relation to the intestinal canal especially that the curative effects of remedies depend. A strong analogy is also thus supplied in proof of the primary action of many of the profoundly morbific agents upon the alimentary mucous tissue; since the positive remedial agents are as truly, though more transiently, morbific (§ 901). It may be one part or another of that tissue,—where it traverses the nose, or the mouth, or intestines, according to the special virtues of the operating cause, and the natural or acquired modifications of the vital states in either part (§ 150, 649 *b*), just as one mental emotion or another will, through *direct* nervous action, strike at this part or at that of the foregoing tissue, or again descend upon other parts of the organ as it may fluctuate in its vital states; or, at other times, may aim at other organs (§ 227, 500). The mucous texture of the lungs is, also, doubtless, often the seat of morbific influences from external agents; though here we have no great range of analogies.

649, *d*. The reason why the skin is so little susceptible of the influence of morbific and remedial agents consists partly in the protection which is afforded by the cuticle; not, however, because of its supposed impervious nature which is inculcated by the mechanical philosophy, but that the cuticle is a mere shield to the very susceptible properties of the true skin. When, therefore, that guard is removed, numerous agents operate with great and rapid effect, and send their influences abroad with great power over the system. Hence, one of the obvious final causes of the cuticle.—*See* p. 930, § 1088 *b*.

650. Every distinct morbific agent (and every remedy), however allied to others, has its peculiar virtues, which produce, *cæteris paribus*, a general corresponding modification of the vital properties and functions (§ 52). If two or more be united, chemically or mechanically, the compound is an agent of new virtues, and produces corresponding effects (§ 188½, *d*). This is the reason for combining remedial agents. Hence arise many varieties of inflammation, and of idiopathic fever; the differences being greater where the morbific causes differ most from each other, or, as two or more may operate (§ 766). This is rendered distinctly obvious by the specific character of those diseases which follow the application of morbid or healthy animal poisons in each of the cases, respectively. Thus, the poisons of small-pox, of measles, of scarlet fever, &c., always affect the vital condition in nearly one uniform way. From these distinct and strongly-marked affections we might safely reason to all other morbific agents; but, independently of this analogy, which rarely fails in relation to any organic laws, we have the same proof, though less remarkable, in respect to other affections. In the great family of idiopathic fevers, among which there are close resemblances, there is no rational doubt that each variety depends upon specifically different predisposing causes. It appears, also, to be well ascertained that these causes are of vege-

table origin, and that the differences in their nature depend upon different combinations of their elementary principles, that take place during the decomposition of vegetable matter. This difference in decomposition, and the consequent generation of each peculiar poison, according to the new and exact modes in which the elements recombine, is owing to various chemical influences; such as peculiar states of the atmosphere as to heat, moisture, light, &c.; and also upon the kind of vegetable matter, its simplicity or variety, the nature of the soil, whether wet or dry, whether impregnated with fresh or salt water, or whether the vegetable matter be superficial or mixed with earth, &c. Certain climates, cities, &c., will generate varieties of fever, and of other diseases, which never happen in other places (§ 1068, *b*, *note*).

All the foregoing has its exact analogies in the natural agents of life (§ 136).

651, *a*. The predisposing causes, nevertheless, give to disease no small part of its special character, while in each tissue, or part of a tissue, of any given organ, the exact pathology also depends on the special vital constitution of that part (§ 132–152).

651, *b*. Age, sex, habits, &c., exert, also, certain influences upon the results of the remote causes of disease; and it is owing to analogous changes in the vital states that the usual effects of any morbific cause in ordinary constitutions may be variously modified in constitutions which possess natural or acquired peculiarities, &c. The influences left by former diseases, and whatever may have diverted the properties of life from their perfectly natural character, or have increased their susceptibility, will be conducive to the deleterious action of morbific causes, and of many of the ordinary stimuli of life, and may variously modify the results in the several cases, respectively. Hence there is scarcely a limit to the modifications of disease, while they may agree in the general outlines (§ 153–156, 163, 535–630).

652, *a*. By no circumstances, however, is the pathology of disease so greatly determined as by the predisposing causes; and this important result, therefore, will be more or less affected by the simplicity or the variety, and intensity, of the causes, as well as by their nature (§ 722).

652, *b*. But, there is not only one predisposing cause which is generally most important, and which mostly rules the pathology, but there are many morbific agents which are capable of so controlling all other influences as to determine certain uniform morbid conditions, whose symptoms may be foretold; particularly the healthy and morbid animal poisons. The contribution, however, which is often made by other causes as to the intensity and complications of exact diseases is well manifested in epidemic scarlatina, epidemic measles, and epidemic dysentery (§ 630 *e*, 663, 827 *e*, 961–970, 1002–1005).

652, *c*. The precise vital influences of any remote cause, their dependence upon the exact nature of that cause (all other things being equal), is critically displayed by the effects of slightly varied mechanical agents. Thus, "a mere prick or scratch is usually followed by cutaneous erysipelas; but not so with a deeper wound; and a punctured wound is less likely to induce it than a lacerated one" (§ 722, 725. Also, *Med. and Phys. Comm.*, vol. i., p. 610; vol. ii., p. 474–480). And so in the same critical sense of the acclimated subject when a new epidemic influence may prevail, as set forth in section 551.

More striking distinctions, and according to the nature of the cause, are shown by such agents as opium, cantharides, mercury, the virus of snakes, of the mad dog, of small-pox, measles, scarlatina, &c.

The importance of enforcing this fact, in a *practical sense* at least, is shown by a common disregard of the subject, as occurs in the following example. Thus,—Pereira, in his erudite work on the Materia Medica, very justly says, that, "the *precise* pathological condition of the brain and spinal cord of an animal under the influence of hydrocyanic acid is matter of conjecture." But he adds,—"Whatever it may be, it is probably *identical* with that which occurs during an epileptic paroxysm, and with that induced by loss of blood." Now, loss of blood will often remove an epileptic paroxysm, at once; and is the best remedy for the cerebral congestion induced by hydrocyanic acid, after the depressing effect of the acid is over.

652, *d*. The physiological inquirer will not fail to apply the foregoing facts in opposition to the chemical and physical hypotheses of life and disease.

653, *a*. Animal or vegetable poisons, if natural or healthy, are the product of natural organic actions; if morbid, they are generated by diseased actions; if altered from the foregoing conditions, they are more or less the product of chemical decomposition.

653, *b*. Since, also, every *specific* disease requires its exact cause, and as every cause of disease which is elaborated by the living organism requires a certain precise state of the organic properties and functions for its production, (or if more or less of a chemical nature it has lost its original peculiarities,) it follows that the disease which is produced by a healthy animal or vegetable poison cannot be generated by a morbid one, and *vice versa*, nor can a chemical product become the cause of a disease which is induced by poisons that are exclusively the product of organic action, as in small-pox, measles, yellow and typhus fevers, &c. And since small-pox is produced by a morbid organic product, and can never, therefore, arise from another cause, and can be alone propagated by contagion, so, also, as the foregoing fevers depend, in certain known instances, upon the products of vegetable decay, they can never be of a communicable nature. Nevertheless, other causes may predispose the body to the operation of the more specific predisposing agents, so that small-pox, measles, &c., may be unusually epidemic and malignant (§ 630 *e*).

653, *c*. Healthy animal poisons, therefore, are never generated by the diseased processes which they excite; but the morbid ones are reproduced by such processes, and by no other, and mostly by individuals of the same species, while the same law of individuality is universal as to healthy animal poisons.

653, *d*. For the foregoing reasons no contagious disease can ever be propagated by any other cause than such as is generated by that precise modification of the vital states which constitutes the essence of the disease. By the same inductive process all those affections which have for their causes the products of laws which govern inorganic matter can neither be regarded as contagious by the philosopher, nor shown to be so by the man who doubts every thing but his senses. The laws of life and the laws of chemistry are as wide as the poles from each other. No organic action can form the chemical combinations of dead matter, nor can the forces of chemistry imitate the mor-

bid any more than the healthy products of life (§ 43, 44, 52, 53, 150, 191 *a*, 409 *c*, *d*, 447½ *c*, 630 *e*, 758, 773, 777–780, 1057 *e–g*).

Since, therefore, miasmata produce yellow fever, plague, typhus, &c., it clearly follows that the living system, when affected by those diseases, cannot generate a poison capable of producing the same affection in others, since the poison depended originally upon vegetable decomposition (§ 657 *b*, 741 *b*). "*Veritas latet in puteo.*"*

But, independently of this incontrovertible law which is predicated of numerous facts in physiology and pathology, and without one to invalidate its force, the whole of this question as to the contagiousness of fevers is settled negatively by a great variety of direct observations. (See *Objections to the supposed Contagiousness of Yellow Fever*, &c., in *Med. and Phys. Comm.*, vol. i., p. 445–453, *note*, 532–534; vol. ii., p. 511.)—Also, § 1068 *b*, *note*. [Just now, 1860, suddenly abandoned.]

654, *a*. Specific predisposing causes, consisting of animal, and mineral, and most of the vegetable poisons, generally produce their sensible effects with great rapidity. Even vegetable miasmata, in a state of concentration, may determine an attack of idiopathic fever as soon as their operation begins (§ 648). It is upon this rapidity of effect that much of the utility of the materia medica depends (§ 554). I have accumulated examples of this nature in the Medical and Physiological Commentaries (vol. i., p. 471–474, &c.). But as no small number believe, with Louis, that "it is not true, as has been said too often, that *facts* do not become old, and the *immense majority* of them have become so; and, moreover, those which we collect in *these times*, will, in like manner, in their turn, become old" (the "numerical method" to the contrary notwithstanding, *ibid.*, vol. ii., p. 810), I shall, I say, in view of this skepticism in respect to "facts" (§ 5¼, *a*, *e*), present an instance fresh from Bombay (1846) relative to the malignant cholera, and as yielding "food for the mind contemplative." Thus, the writer:

"Who shall depict the scene in the hospitals? I speak more of the Fusiliers, because of that I saw much; every cot was filled—delirium here, death there—the fearful shrieks of pain and anguish. Men whom you had seen a short time before hale and strong, were rolling in at every door, crowding every space—countenances so full of misery—eyes sunken and glaring, shriveled and blackened cheeks. This, too, the work of five short minutes or less! So sudden was death with some, that they were seized, cramped, collapsed, dead, almost as fast as I have written the words. Previous health and strength were no guaranties; men attending the burials of their comrades were attacked, borne to the hospital, and buried themselves the next morning. Pits were dug in the church-yard morning and evening; sewed up in their beddings, coffinless, they were laid side by side, one service read over all."

The foregoing paragraph, as well as the facts to which I have just referred, in another work, may remind the reader of what has been said of the action of hydrocyanic acid, nux vomica, &c., and lead him to appreciate the analogies in the modes in which morbific and remedial agents bring about their results, and strengthen his philosophy of the properties and laws of organic beings (§ 494 *dd*, 827 *d*).

654, *b*. The foregoing, however, is not equally true of morbid animal poisons, which are alike specific. I may also say, as farther il-

* A remarkable plagiarism of the foregoing argument (§ 653 *a–d*) was exposed by a correspondent in *American Medical Gazette* (N.Y.), December, 1859. "*Veritas vincit.*"

lustrative of great vital laws, that morbid animal poisons have, commonly, the remarkable attribute of producing their sensible effects at more determinate periods than any other predisposing causes, with a few exceptions like the hydrophobic virus. It is also another striking fact, that natural small-pox occurs in about fourteen days after exposure, but that the intermediate period is only eight days where the same disease is communicated by inoculation. The disease, too, is violent in the former, and comparatively mild in the latter case; thus showing that slight variations in the condition of the predisposing causes will not only vary the duration of the predisposition, but modify all the phenomena of the ensuing disease (§ 650, 651). This is more particularly seen in the relative history of natural small-pox and the cow-pox, which are, essentially, one disease. It is an example, also, which illustrates the specific modifications of the properties of life in different animals; since we know of no other than the cow (certainly not the human species) that can so alter the variolous poison (§ 545. Also, *Med. and Phys. Comm.*, vol. ii., p. 184, 195–200).

654, *c*. Again, there may be an interval of weeks, months, and years, after the application and the removal of the predisposing cause, before disease ensues. This is witnessed particularly in some remarkable exceptions which occur among the specific causes; as those which generate intermittent fever, while the same causes may also develop an attack with great rapidity (§ 654, *a*). "When a cause is applied which produces fever," says the philosophical Fordyce, "it produces it *uno ictu*, although the cause be no longer applied. Neither is it increased, diminished, or altered, by the farther application of its cause."

654, *d*. Where the sensible effects follow rapidly the application of the causes, the predisposing is generally adequate to the full production of disease; and it may be equally so where the interval is longer, as in small-pox, hydrophobia, &c., though more commonly some exciting causes are necessary, as probably in a large proportion of idiopathic fevers. Hence, an attack of these diseases may be often prevented by a proper regimen, but not by medicine.—Note S p. 1124.

655. Specific causes commonly operate with greater certainty than the general (§ 646); and this is owing, in part, to the circumstance, that the former generally act both as predisposing and exciting causes. But, even the effects of these may be moderated by a proper regimen. Low diet, for instance, after exposure to small-pox, measles, scarlatina, &c., or after inoculation, or exposure to the causes of fever, will lessen the severity of the disease. The principle is the same as when a stimulant diet, &c., contribute to their production (§ 663).

656. The ordinary exciting causes, which, in their usual force, commonly fail of producing disease where a morbid tendency has not been induced by predisposing causes, may readily become predisposing, or both together, by a greater intensity of action.

657, *a*. It commonly happens, especially in acute diseases, that, when predisposing causes are not followed immediately by a development of disease, the principal morbid states take place in organs distant from that on which the morbific causes exert their direct action. The main predisposition, therefore, is produced by reflected nervous action; and of course it is there that the principal explosion of disease takes place. It is subsequent to this, that the surfaces

on which the agents exert their direct action become sensibly involved in disease; and then it is probably quite as much a result of sympathetic reaction from the organs where the main explosion takes place (§ 148, 514 *h*, 524 *c*, 743). This is especially true of the alimentary and pulmonary mucous tissue, and of the skin, upon the former of which malaria appear to exert their direct action. The principle is seen distinctly in the pulmonic inflammation, rheumatism, &c., which follow the action of cold upon the skin, and in the application of mercurial ointment, and other unirritating remedial agents, to the undenuded surface (§ 649, *c*). And so of other remedies addressed to the stomach. They commonly exert their most sensible effects upon the remote parts now rendered particularly susceptible by the presence of disease (§ 137, *d*). But examples of remedial influences more in point occur in subsequent sections (§ 902 *m*, 905). In respect to morbific causes, however, there may not exist any preternatural susceptibility of the distant parts, but the agents establish their effects in conformity with laws already indicated (§ 150, &c.). The propagation of their influences in the foregoing manner is replete with problems of the deepest interest in medicine, and reason is often conducted to the truth by a firm hold upon a long chain of analogies. In this way, for example, we arrive at a knowledge that hydrophobia follows the law of propagation by nervous influence. The hydrophobic virus establishes certain imperceptible morbid influences upon the bitten part, which are by reflex action propagated over the system; and here, as in miasmatic fever, the predisposition is sufficiently formed in various other parts as not to require, for the general explosion, a full development of disease in the bitten part. There are commonly present, however, in hydrophobia, symptoms which denote either inflammation or morbid irritation of the injured part, just antecedently to the general explosion, which is precipitated by it. Hence, also, the reason why the removal of the bitten part, many days, or even weeks, after the infliction of the wound, may prevent hydrophobia; which it would be absurd to explain by the humoral philosophy of this disease (*Medical and Physiological Commentaries*, vol. i., p. 499–505).—NOTE D.

657, *b*. It will have been seen that a peculiarity attends idiopathic fever in its universal invasion of the body (§ 148, 757, &c.); and this leads me to indicate a certain difference in the sympathetic propagation of the predisposing influences from what may obtain in the more circumscribed forms of disease. In the operation of the predisposing causes of fever, the reflected nervous influence from the direct seat of morbific action gives rise to coincident pathological states throughout the system, where there is no interference from inflammation or venous congestion; while other morbific causes are apt to result in various modes of disease, as the effects of sympathetic influences radiated from their seat of action. In the former case, therefore, the general extension of reflex nervous actions is equivalent, in principle, to a specific universal action of the original predisposing cause (§ 228, 653, 516 *d*, no. 6, 638½).

658. If disease be limited to the part on which the morbific cause makes its direct impression the changes may be then instituted by the direct action of the cause upon the organic properties, and without any necessary intervention of the nervous power. And so of remedial agents, as when caustic is applied to ulcers, unguents to the skin, &c. But,

it more commonly happens that the reflected nervous power is the immediate agent in the production or cure of disease, though seated in the part to which the morbific or remedial agent is applied. This reflection of the nervous power may come either directly through the nerves supplying the part, or from organs more remote (§ 184, 188, 205–216, 222–233⅘, 475–492, 493 *cc*, 500, 514 *b*, 647½, 893½, 902, 905 *a*).

659, *a*. Predisposing causes are often involved in much obscurity, especially when of a complex nature. Their operation may have begun at some remote period, and there may have been a long consecutive series without much relation to each other. Neither may be sufficient to lay the foundation of disease; but each renders the properties of life more and more susceptible to morbific influences from other causes, but which, otherwise, might have been innoxious. These new causes being applied, one after another, alter more and more the natural condition of the vital properties and functions, till, at last, some new, and perhaps as mild a cause, produces a sudden explosion of disease. This last cause is often mistaken, and often fatally for the patient, as the principal, or only source of a malady which has been the slow consequence of a long series of causes. And so of the last remedy, after a series of remedial influences.

Thus it frequently happens that the first in the chain of predisposing causes begins in childhood, and the last does not take place till adult age. The gastric and hepatic inflammations which supervene on the indigestion of adult life have often grown out of improper food in childhood, and a neglect of other natural habits, which are continued till habitual indigestion sets in. It then becomes difficult, from the influence of habit, to accomplish a cure; and these patients, too often indisposed to exercise self-denial, go on with persevering indulgence, and carry forward the morbid changes till obstinate and even disorganizing inflammations ensue (§ 548). Such, too, is the frequent history of intemperate drinkers, excessive tobacco chewers and smokers, opium eaters, &c.; the poison being slowly morbific in all the cases, but aided in its operation by many concurring causes (§ 524 *c*, 527 *b*, *d*, 548, 578, 630 *e*, 714, 902 *c*, *m*, 905 *a*, 970 *c*, 1066).

From this combined series of causes, and their gradual influences upon the vital conditions, there is every variety and gradation, as to number, time, activity, &c., down to those which, like a scald, or the bite of a venomous snake, develop inflammation at once, or, like prussic acid, extinguish on the instant, and without any other antecedent change, the entire powers of the organic being.

659, *b*. The foregoing gradual operation of morbific agents lays the foundation of the scrofulous diathesis (§ 836), and is analogous, in principle, to the philosophy of acclimation, and to the formation of artificial temperaments (§ 558, 560–563, 591). The causes, indeed, being perhaps not remarkably different, and only morbific under special circumstances, may transform the melancholic into the sanguineo-melancholic, or into the nervous temperament, instead of producing chronic indigestion, or some habit of feeble health (§ 535–540, 602).

660. In the last section we have examples of what is in constant progress in disease, namely, the predisposing influence which a diseased organ exerts on others which were not diseased. These morbific reflex actions, leading to various sympathetic diseases, then fall within the category of predisposing causes; as may also the resulting

diseases; but, if they concur only in a secondary manner with other causes, then they may be only exciting, or both exciting and predisposing causes (§ 143 *b*, 222–232, 514 *h*, 647, 715).

661. Finally, all those hereditary peculiarities, in which there is a natural tendency in the vital states to take on diseased conditions, may be included under remote predisposing causes. But this is rather for the sake of convenience, since, in the hereditary constitutions, the tendency to disease is virtually no more than the common predisposition to disease, and is equally owing to remote causes which have exerted their predisposing effects upon our ancestors. It is convenient, therefore, to assume these transmitted peculiarities as equivalent to the remote causes themselves. And, although we cannot trace out the remote influences which lay the foundation of the scrofulous constitution, or of other hereditary predispositions, the known characteristic peculiarities of the accidental constitutions is equivalent to a knowledge of the nature of the remote predisposing causes; since in other affections we do but employ our knowledge of the predisposing causes in finding out the exact pathological character of disease. And so, also, of the several temperaments (§ 561, 585, &c.).

662, *a*. A knowledge of the remote causes of diease is often indispensable to the successful treatment of disease. Catarrh, for instance, arising from cold, in a sound constitution, although prolonged, may be suffered to pass without much remedial care; but, if it have for one of its remote causes a natural tendency to pulmonary phthisis, it should awaken all our vigilance for its removal. The reason is obvious. In the ordinary catarrh all the remote causes soon cease their operation, exert no profound nor specific changes, and the vital states soon obey their natural tendency to the standard of health. In the other case remote causes had been in prolonged operation, are more or less of a specific character, and the resulting predisposition has almost the fixedness of the temperaments (§ 543, 548, 561, 562, 585, &c.). In these cases, therefore, the tendency of nature is to go the wrong way; and in proportion to this she requires the intervention of art. We must then make repeated impressions upon the diseased conditions before we can establish the artifical changes, before we may counteract the naturally morbific tendency. This being accomplished, a favorable inclination is given to the balance of nature, and she comes in with languid efforts at restoration.—NOTE F.

662, *b*. Again, a fever, or inflammation, with partial remissions, presents itself. The fate of the patient may now depend upon our knowledge of whether the principal remote cause consisted of marsh miasmata, or of some other morbific agent, although it have long ceased to operate; since, in the former case, the Peruvian bark, arsenic, &c., may be indispensable, while in the latter they would be destructive (§ 870). It often happens, also, where the remote cause is still in operation, that its removal alone, especially those of a *general* nature, may be all that is necessary to a speedy cure (§ 648, 815).

Venous congestions, as will be seen hereafter, may be also attendant on intermittent fever, which shall ultimately require the Peruvian febrifuge, but which would be aggravated in most other cases. After bloodletting, it is the great remedy for the intermitting apoplexies of Italy, &c. In all these cases, the congestive affection is peculiarly modified by the nature of the predisposing cause (§ 816, 817).

662, *c*. Again, it has been always found, on dissection, that *delirium a potu* was attended with venous congestion of the brain; and such is the modifying influence of the remote cause that one of its frequent remedies is opium, and in quantities that would induce another modification of the same disease if administered in healthy states of the system, and for which bloodletting and coffee would be the remedies. This peculiar fact impresses us forcibly as to the wonderful modifications which different morbific agents establish in particular forms of disease, and enforces the importance of ascertaining the nature of the predisposing cause. Striking examples occur in the self-limited diseases (§ 858, 861). In *delirium a potu* antiphlogistics should prevail.*

663. The remote causes which readily produce disease in one man may not in another. Thus, during the prevalence of an epidemic fever, or the malignant cholera, or influenza, a greater portion of the inhabitants may escape the disease. There is, therefore, something appertaining to that part of the multitude which escapes that enables them to resist the morbific effects of the prevailing remote cause (§ 648, *b*). And here observation, as well as vital philosophy, enables us to understand the reasons, and how epidemics may be baffled.

We find, for instance, in respect to yellow fever, and all other congestive fevers, prevailing epidemically, that their subjects are apt to live on, after the appearance of the distemper, without much regard to their habits. They eat as freely as usual of animal food, drink their wine, and perhaps more ardent spirits. Others have become infirm from irregular habits, and such are, in consequence, rendered more susceptible of the epidemical influence (§ 827 *c*, *e*).

On the contrary, we observe that the class who escape are more generally abstemious, eat less stimulating food, or renounce it altogether, abandon all alcoholic liquors, avoid the night air, retire early to rest, &c. (§ 615, &c., 623–625, 645 *b*, 630 *e*).

And so, where there exist constitutional or other tendencies to disease; its attack may be averted by habitually avoiding many agents which are inoffensive to others (§ 150). Peculiarities in respect to temperament are, also, often concerned in the degrees of susceptibility to the influence of morbific agents; just as they are in respect to remedial. The sanguine, for example, will be more the subjects than the melancholic or the phlegmatic; and the former require greater vigilance as to exciting causes (§ 551, 597, 598).—Note Oo p. 1141.

664. Certain predisposing causes sometimes extinguish the susceptibility to their morbific action even in concentrated degrees when they have been long in operation in degrees less intense; as in acclimation, the use of tobacco, &c. (§ 544, 545, 551). Some other causes always, or nearly so, destroy the susceptibility to their action through all future time after having once produced disease. These consist, mostly, of a few morbid animal poisons; namely, of small-pox, measles, scarlatina, hooping-cough, and mumps. It is remarkable, too, that all these diseases are contagious without contact, and are the only ones to which this combined law applies (§ 545, 654 *b*).

665. Predisposition often remains after disease shall have been apparently eradicated; as seen particularly in intermittent fever, and in chronic indigestion (§ 514 *g*, 560). This persistence of predisposition is most likely to occur where some organic derangement may have supervened, or where a low chronic state of disease may estab-

* In the *Med. and Phys. Comm.* (vol. 2, p. 485–491), I have shown that tart. antimon., cathartics, and often bloodletting, are generally the best remedies for *delirium a potu* (§ 1058 *y*).

lish itself in some comparatively circumscribed part, and which not only contributes to maintain the general predisposition, but afterward increasing, becomes one of the exciting causes of another attack of fever (§ 806). These local conditions are generally owing to imperfect treatment; to the neglect, perhaps, in intermittent and remittent fevers, of proper depletion, or to the use of excessive doses of quinia, &c. Acquired predisposition to particular diseases, however, often appears to be almost as firmly ingrafted upon the constitution as those of an hereditary nature, with intervals of apparent absence of all disease § 535, &c.). *Acclimation* is also a study for the philosopher (§ 554).

666, *a*. Predisposition to disease consists in some indefinite change which has befallen the organic properties, and corresponds, in a general sense, with the peculiar virtues of the predisposing causes (§ 650, 652). Where the subsequent development of disease is severe, and especially if sudden, there has been, obviously, some profound antecedent impression upon the properties of life, instituted by the local operation of the remote causes, and propagated to other parts by alterative reflex actions of the nervous system. In fevers, especially, obscure symptoms may be seen some time before the sudden and full explosion of disease (§ 143, 227, 500 *dd*, 514 *g*, 685, 686, 764, 777, 785, 807, 811).

A morbific impression being once made on the changeable properties of life it may go on increasing in intensity, although the remote cause have been early withdrawn, till, having acquired a certain degree of force, disease may either explode spontaneously, or some mild exciting cause may institute a sudden and violent change in the now highly-susceptible properties of life (§ 506, 512–514, 516 *d*, no. 6, 518 *b*, 561, 618 *a*). At other times the predisposition appears to be stationary, perhaps for months, and even for years, as seen in fevers and hydrophobia; the former having been known to exist in a dormant state for a year or more, and the latter for seven years.* In these cases, it appears ultimately to assume, of itself, a tendency toward a full development (§ 148, 514 *g*, 559, 561, 715, 826, 657 *a*).

666, *b*. A distinct apprehension of the nature of acquired predisposition to disease may be had by referring to the philosophy of artificial temperaments (§ 591, 602, 603), and to those naturally modified states of the vital properties which so frequently result in hereditary diseases; as in scrofula, gout, bronchocele, &c. In some of those natural conditions which predispose us to specific modes of disease (§ 661) there is no apparent departure from a state of health, unless disease be developed by exciting causes (§ 645, *c*); and this will be true in proportion as the predisposition is limited to a few parts, and especially if those few be not important to organic life. Thus, the predisposition to gout is greatly limited to the small joints, though it may affect other parts, especially the intestinal mucous membrane. So, in bronchocele the predisposition resides in the thyroid gland. In such constitutions, therefore, there is not generally any thing present, under ordinary circumstances of health, to denote any modification of the properties of life which approximates a condition of obvious disease. These cases are so far closely allied to those conditions in which the predisposition to fever, or to hydrophobia, is in a state of incubation for many months, or for years (§ 238).

But, in scrofulous subjects it is generally otherwise; since in those who are naturally predisposed to scrofula the tendency to the disease

* An apparently clear case in London Lancet, February 3, 1838.

is more or less universal, and may affect almost every tissue and organ. There is, therefore, a natural radical fault in all the organic endowments of the system, and this fault or natural modification constitutes the predisposition (§ 661). Hence, in such subjects, the very elements of the body are diverted more or less from their perfect standard, and the union of their compounds into tissues and organs deviates, more or less, from that of natural subjects (§ 220). Irritability, especially, is not only permanently turned from its natural character, but is at all times preternaturally susceptible; and hence it happens that occasional causes, innocent in health, operate now with morbific effect (§ 143–150). These cases approximate those acquired predispositions where incubation is of short duration, and where there can be no doubt that the organic properties sustain a profound lesion during the early operation of the predisposing cause, or take on, at an early time, a progressive tendency toward an explosion of disease (§ 76, 181, 638½, 645 *c*).

II. PROXIMATE, OR PATHOLOGICAL CAUSE.

667. The *proximate* cause, as implied by the term, is that from which all the direct phenomena of disease arise. It must therefore constitute the essence of disease itself; and hence I substituted in the Medical and Physiological Commentaries the term *pathological* for proximate, and have since retained it as more expressive than the original name when used in the sense here intended.

668. The remote causes, by their action upon the properties of life, lead to that change in their condition which forms the essential pathological cause, or the essence of disease (§ 644, 658, 666). As a necessary result, there also follows a corresponding change in the functions over which the properties preside, and therefore a more or less modified action of the vessels which are the instruments of disease (§ 247). All the symptoms, altered secretions, lesions of structure, &c., are only consequences, more or less remote, of those primary changes.

669. Since, also, it appears that all remote causes which differ in their virtues, or in their modes of influence, establish changes in the properties and functions of life corresponding, in a general sense, with the nature of the causes, and with the modes and intensity of their operation, it follows that the pathological causes, or results of the predisposing, must vary in a corresponding manner (§ 650, 651).

670. But there are many remote causes that are so nearly allied in their morbific virtues that they must produce pathological conditions of near resemblance. Such are the various remote causes of inflammation, and that other class which gives rise to idiopathic fevers. Since, however, many of the causes belonging to each class have certain very peculiar virtues of their own, there must necessarily arise corresponding peculiarities in the pathological conditions which they produce. Hence the very obvious differences which prevail among inflammations and fevers; though more or less is due to the nature of the affected parts, and often to many contingent influences. Inflammation of the venous tissue, for example, presents a combination of phenomena that distinguish it at once from inflammation of any other tissue, though the remote causes be the same. Much of the variety in congestive fevers is also owing to some inflammatory

state of one or more organs; while, also, venous inflammation is variously modified, as in all other tissues, according to the nature of the remote causes (§ 132–140, 149–152, 652, 722, 765, 766. Also, *Med. and Phys. Comm.*, vol. ii., p. 427–514).

671. Summarily, then, the precise nature of the pathological cause will depend upon the nature and action of the remote cause, or their combined nature when two or more operate efficiently, and upon the natural or other antecedent modifications of the vital properties of the affected parts, and the general nature and vital relations of any compound organ of which an affected tissue may form a component part; subject, however, to modifications from temperament, age, habits, &c. (§ 150).

672. Every disease consists of a succession of pathological causes, till they end in health, or in death. These changes are the result of the natural mutability of the properties of life, especially when once diverted from their healthy standard. The morbid states are rarely stationary from one hour to another. They fluctuate, favorably, from the inherent tendency of the properties to return to their natural condition, or from artificial impressions from remedial agents; or, unfavorably, from the intensity of disease, the force of predisposition and of habit, or from the continued operation of predisposing or exciting causes, &c. (§ 177–184, 535, &c., 666, 733 *e*). The progressive changes may be gradual, and require but slight modifications of treatment, or great and abrupt; and either condition may follow the same morbific and remedial agents, according to the surrounding influences.

The absolute condition of disease, therefore, is changing not only spontaneously during its progress or decline, but is variously modified by remedial agents, and by other contingent causes (§ 733, *d*).

673. It is to the actual condition of disease, and the organs involved, that remedies should be directed. A knowledge, indeed, of the seat of disease, and of its exact pathology as far as may be attained, is often indispensable to a successful treatment; and here a knowledge of the remote causes may contribute the greatest light (§ 650).

So, also, at every successive application of remedial agents the new pathological conditions should form the ground of the new prescriptions.

674, *a*. Upon the modified conditions of the properties of life, or their pathological states, therefore, all the modified actions of the vessels which are the instruments of disease, all the vital phenomena, and all the physical products depend; just as the healthy actions, phenomena, and products depend upon the same properties in their state of health (§ 177, 410). It is for this reason, the modification of the vital properties in disease, or the essence of disease itself, is called the proximate or pathological cause; all the rest being merely results or effects.

But, there are only certain facts that may be understood in relation to the changes which the organic conditions sustain from the operation of morbific causes. We can see distinctly that they are exalted in inflammation, and exalted or depressed in fevers. But these are comparatively unimportant elements of the changes. There is also the greater change which consists in some absolute modification of the *nature* of the properties, some positive change in *kind* (§ 177 666). What that change is it is impossible to comprehend, though it

be the essential part of the disease. We know not, indeed, the absolute nature of the vital properties in their healthy state, and have, therefore, no standard of comparison in disease. We may, nevertheless, by the phenomena, as of all other forces of nature, learn all the laws of the vital properties, and the modifications to which they are liable (§ 234). The physiologist, I again say, concerns himself about the facts, the anatomical medium, the existence of the forces and the laws which they obey. He interrogates not the intrinsic nature of the powers, nor the proximate modes in which the results are produced.

674, *b*. For the purpose of having some visible or tangible condition before us in considering the pathology of disease, we often include some of the results as elements of the proximate cause, or even substitute some of the results for the cause itself. Thus, increased action of the capillary blood-vessels is often said to be the proximate or pathological cause of inflammation, though this is only a consequence, however a necessary one, of a certain morbid alteration of the vital properties of the vessels concerned in the morbid process. So, the pathological cause of venous congestion is said to consist in an accumulation of blood in the veins, though this is a very remote consequence. As a better designation, according to my exposition of the pathology, and since venous congestion is assumed as a particular disease, I would say, for the sake of brevity and convenience, that its pathological cause is sub-inflammation of the veins; the accumulation of blood being only a remote effect. And so of active phlebitis, or of any other inflammation which derives its name from the part affected. Such, indeed, has become the specification of common inflammation in almost every part of the body. But, in all these cases, inflammation is an aggregate term which stands for that change in the organic properties which is the true pathology.

674, *c*. But what is the pathological cause, in the foregoing comprehensive sense, of other diseases, as fever, &c.? Here we have less light as to the nature of the changes, even of function; and hence there is less guide from general principles, and more abstract dependence upon symptoms and experience. Still, as will be seen, the pathology and treatment of fever are not without their important general precepts. We reach a knowledge of the modifications which the physiological laws undergo, and this is the most that we require for the institution of medical principles.

674, *d*. The vital states of a part or of the whole system may be variously modified in their condition so as to approach nearly to actual disease, and yet the modification fall short of the absolute change. This has been already seen in what I have said of predisposition to disease, whether accidental or hereditary. It is also constantly illustrated by the manner in which the heart sympathizes with every part which may be the seat of morbid action, and upon which the variable state of the pulse greatly depends. This prominent demonstration of reflex nervous action may be carried to all other organs, which, in like manner, are liable to sustain sympathetic disturbances short of disease, but according to their own natural modification of the properties of life, especially of irritability (§ 133–136, 188). And, although these conditions do not amount to absolute disease in its common acceptation, they may reverberate morbific influences upon parts sus-

taining a greater lesion, and often call for the intervention of art (§ 714, 848). Or, such influences may give rise to severe forms of disease in other parts. Thus, gastric derangements, not inflammatory, may induce severe inflammation of the mucous tissue of the throat, or hepatic or cerebral congestion, &c. (§ 500, 689 *l*). Again, certain morbific causes, acting upon the stomach, make their principal demonstrations in remote parts; as the narcotics, cantharides, &c. A simple element of this is constantly seen in the manner in which cold on striking the skin will develop catarrh, pneumonia, &c.; though, in the former cases, there may be specific relations of the morbific agents to particular parts, while in the latter, other predisposing causes may have operated (§ 147–151, 649 *c*, 657, 722 *b*). This principle lies at the foundation of all the consecutive developments which may spring up in different parts as the consequences of some primary derangement of a particular part, or of some local morbific impression which may come short of apparent disease in the organ impressed.

In sections 143, 666, 847, 848, I have endeavored to show how the whole system may be brought, by reflex nervous actions, into that condition, and how, in consequence, remedial agents will then exert a salutary effect upon all parts, when they might fail of any effect upon the same parts in their state of health; and how, also, in consequence of such remedial influences, the morbidly sympathizing parts may be made the sources of salutary reflex actions upon the primary disease; as may, also, such as have not sustained a morbific influence (§ 514 *h*, 638½, 657 *b*).—NOTE D p. 1114.

675. As illustrative of some of the foregoing sections, particularly the last three, I shall now present an example of a therapeutical nature, but which takes, in its comprehensive range, the causation and philosophy of disease, the principle upon which morbific and remedial agents operate, whether directly upon the vital properties or through the medium of the nervous influence, the analogy between the operation of morbific agents and remedies, and how the last may prove, through a common principle, either remedial or morbific.

I shall assume, for the foregoing purpose, the intermittent fever, in which the whole system is engaged; and to simplify the treatment, bloodletting, nauseants, and quinine, may be the agents employed. Each of these agents, like all other therapeutical means, operate entirely upon vital principles, as set forth in the appropriate places in this work. Will the chemist and humoralist give their attention?

Now, without the aid of the philosophy which has been hitherto considered we could not comprehend, in the least, any of the phenomena of this disease, much less their consecutive relations, as they are regularly presented at the several stages of the complaint; nor could we any better understand the salutary or the conflicting results of our remedial agents. But, the true philosophy of life places the whole subject in a consistent, intelligible, and even sublime aspect. At each of the several stages of an intermittent, the properties of life are in different states of modification, and the remedies must be adapted to their particular modification at the different stages of the disease; or such as may be curative at one stage will either fail of their effect at all other stages, or exasperate the complaint. In the first, or cold stage, the properties of life are profoundly altered; and, as this is the beginning of the paroxysm, the alteration has not ac-

quired that fixedness, or that influence of habit, which results from its prolongation (§ 535, &c.). Powerful impressions may, therefore, be made upon the morbid properties, and, if rightly made, they may at once arrest the paroxysm. But no remedy can be applied with safety at the cold stage which would add to the excitement if applied at the hot stage. No stimulants, therefore, not even quinine, which is so eminently curative during the intermission, can be employed in the cold stage without proving morbific, and an aggravating cause to the hot stage. But, many remedies which are appropriate to the hot stage will tend, more or less, if applied during the cold stage, to produce a change that will mitigate the hot stage, or bring on at once the sweating stage. Of the three remedies proposed, there are two which will often accomplish this result, and cut short the disease at this stage of the paroxysm, or at least conduct nature to an immediate consummation of her cure in the sweating stage. But, the nearer the beginning of the cold stage either of the two remedies are applied, whether loss of blood or an emetic, the more salutary, for the reason already stated, will be their effect. Numerous and striking examples of this important principle might be stated; as, for instance, an emetic will often subdue, at once, pneumonia or croup, if exhibited at their very invasion, when it may be perfectly powerless in a few hours afterward. And so, in a more limited sense, of the abstraction of blood, which reaches more profoundly and more universally all the organic properties, and determines upon them, when syncope approaches, a greater and more universal impression of the nervous power (§ 947, 948). This remedy, therefore, may often answer well at any period of the cold stage, should we determine upon its use.

But, suppose that the hot stage supervene. A new condition of the vital states has now sprung up, and it must be treated accordingly. Whatever will lessen and otherwise favorably modify irritability (§ 188, &c.), and contribute to the production of the sweating process, will be salutary at all periods of the hot stage, and whatever increases irritability and mobility will, as at the cold stage, exasperate the hot stage and embarrass the sweating stage. It is evident, therefore, that quinine will still prove morbific. But we have in certain nauseating remedies, as tartarized antimony, and in bloodletting, appropriate means for reducing and otherwise modifying the morbid state of irritability, in the hot stage. Alterative doses of antimony, even short of nauseating, may now exert a powerful tendency to bring about that favorable change which ensues naturally; while in its full emetic dose, so often favorable near the invasion, or at the onset, of the cold stage, this agent is rarely useful and frequently injurious. Abstraction of blood has the same useful tendency. But, this remedy, unlike its effect, and that of emetics, in the cold stage, will not operate with the greatest force at the beginning of the hot stage, but near the termination of this stage in the sweating process. The properties of life have now assumed a radically different condition. They are rapidly throwing off the influence of predisposition and of morbid habit, and their tendency is toward a restoration of their natural state. Nature is therefore more successfully aided in this new condition as she approaches the sweating or more curative process, which is the final cause of the hot stage. Hence it follows, where the advantage of one impression only can be had from a reme-

dial agent, although it be useful, like bloodletting, at other periods of this stage, it should generally be delayed, at least, till the stage of excitement has reached its acme. If cathartics be employed at this stage, they should be delayed, at least, till the sweating process has begun; and now an emetic may be sometimes salutary. But, the former, partly on account of their irritation, should rather be deferred till the sweating stage is over, while emetics are most salutary just before the invasion of a paroxysm, which, as in the hot stage, is always an inauspicious time for cathartics.

In proportion as nature is going on with a progressive march toward a comparatively healthy result, as in the sweating process, there should be no great interference from art. No help is wanted, for the restorative process will be soon spontaneously completed, and, at an advanced stage of this process, and before it is finished, there will be always danger of making some unfavorable impression, unless it be from remedies of a mild character, whose uniform result is that of acting as sudorifics, and coinciding in other respects with the changes which are in progress during the sweating stage. Such a remedy, for instance, is tartarized antimony, in doses short of nausea.

Finally comes the interval of repose, which is remarkable for its *specific*, but various, duration; giving to intermittent fever its quotidian, tertian, or quartern type. There is, however, notwithstanding the apparent state of tranquillity, very often some morbid condition remaining; as sufficiently denoted by any subsequent return of the paroxysm. In all such cases, there is a progressive change going on in the vital properties from the time of their comparatively natural state at the close of the sweating process toward that profoundly morbid alteration which constitutes the cold stage. The disease is again in a state of incubation, and therefore the tendency to change in the organic properties is exactly the reverse of what had just antecedently existed during the hot stage and its termination in the sweating process (§ 666). It is now the object of art to prevent a repetition of the paroxysm. This may be often accomplished by mere rest in a horizontal posture, and abstinence from all solid food; for the tendency of nature may be the right way, if she be not embarrassed by exciting causes; the slightest of which, as a shock of the mind, may throw her into a state of incubation. This shows not only the great susceptibility of the vital properties, during the intermission, to morbid changes, but, also, their frequent disposition to return, unaided, to their natural state. Should they require any other intervention from art than the mere act of withholding exciting causes, it is manifest, from what I have now said, that slight influences from remedial agents will be amply sufficient; so only we discard pernicious causes, and there be no severe local disease. The remedies for this purpose consist of a group that are called specifics, and have been suggested by experience independently of any general principles; so very peculiar is the state of the vital properties during the period of intermission. Of these specific agents the Peruvian bark and its alkaloids is one, arsenic another, and cobweb another; coming severally from each of the three great kingdoms, and each exerting nearly an equal control over the progress of incubation, but without any other known analogies to each other; certainly none of a chemical nature. The quinine, or arsenic, which would have been surely morbific at any other stage of the paroxysm, may

now be employed with a remarkably curative effect. But, a great error is often committed in exhibiting quinine, in this very tangible state of the organic properties, in excessive quantities; by which the disease is either prolonged, or the predisposition only temporarily subdued, or local affections induced or aggravated. As an invariable and important rule, also, just in proportion as the organic properties are approaching a state of health, so should our treatment be cautiously mild, or it will light up disease (§ 764. Also, *Med. and Phys. Comm.*, vol. i., p. 443, &c.).—NOTE K p. 1119.

676, *a*. In the foregoing section I have stated a problem for the specific object of showing the variety of changes which diseases are liable to sustain in their pathological character during a short period of their progress, and the importance of adapting the treatment to the changes which may ensue, with no other reference to symptoms than as they are indicative of the seat of disease and its true pathology (§ 762). But I have also, incidentally, at the same time, demonstrated the absurdity of attempting any part of the problems of disease, or the modus operandi of remedial agents, by any philosophy borrowed from the inorganic world, or by any hypothesis in the humoral pathology. The vital solidists, however, being numerically small, claim to be little ceremonious with error; and once more, therefore, I shall bring into contrast the adverse doctrines (§ 350¼–376½, 433–450). With this intention I shall submit the philosophy as now taught in Great Britain and France, and leave it to the reader to interpret by that philosophy, if he can, the problems contained in the last preceding section.

676, *b*. It is scarcely necessary to remind the reader that Liebig's speculations in medicine are in general vogue in Great Britain (§ 349, *d*), and have become incorporated in medical works of every description (§ 433). Take the following example, relative to my present topic, from the long-celebrated and able, but now completely metamorphosed, PHARMACOLOGIA of Dr. Paris (§ 339, *b*).

"In a recent work by Professor Liebig, to which I have frequently referred," says Dr. Paris, "we are presented with views not only applicable to the question under discussion, but well calculated to extend our knowledge with regard to the modus operandi of contagious matter, and its reproduction in the living body. I have already explained his important application of the dynamic law of La Place to chemical action; viz., that a body, the atoms of which are in a state of transformation, may impart its peculiar condition to compounds with which it may happen to communicate."

Dr. Paris then proceeds to say, that it "was reserved for the genius of Liebig" to apply this doctrine of "fermentation," "putrefaction," &c., to the living body, in explanation of "the modus operandi of contagious matter," &c. I had occasion to set forth this philosophy of the Continental Chemist in my *Examination of Reviews*, together with the principal examples by which it was sustained (p. 55). Some of them occur, also, in the present work (§ 350, nos. 29 to 46, and 78 to 97). Of the "sausages," by-the-way (to illustrate the extent of acquiescence), it is said by Dr. Paris that, "by entering the blood, they impart their peculiar action to the constituents of that fluid, and *all the substances in the body are induced to undergo a modified putrefaction*" (§ 339 *b*, 349 *d*, 350, no. 44).

I shall not pursue this subject farther, having, in the *Medical and Physiological Commentaries* (vol. i., p. 385–716), devoted an Essay to the merits of the Humoral Pathology, where all the foregoing points, the "sausages," &c., are duly investigated (§ 282).

And now to complete this example of sudden and general illumination, and to exemplify, again and again, "the recent progress of medical science" under the auspices of "experimental philosophy," let us hear Dr. Paris as he was at a former edition of his Pharmacologia, and when he and others were just as much enlightened as to the connection of chemistry with the healthy and morbid processes of man as when he put forth the ninth and last edition of that distinguished work. Thus:

"Every *rational* physician must feel, in its full force, the *absurdity* of expecting to account for the phenomena of life upon principles deduced from the analogies of inert matter; and we therefore find that *the most intelligent physiologists of modern times* have been anxious to discourage the attempt, and *to deprecate its folly*."

In descanting upon the interference of the celebrated chemist, Mr. Brande, with medical topics, Dr. Paris remarked, that

"*Whenever the chemist forsakes his laboratory for the bed-side,* HE FORFEITS ALL HIS CLAIMS TO OUR RESPECT AND HIS TITLE TO OUR CONFIDENCE" (§ 709, 1006 *a*, 1034).

III. SYMPTOMS.

677. *Symptomatology* is the third and last division of pathology; being the doctrine of *symptoms*. It embraces all the phenomena which result either directly or indirectly from morbid states, and includes, therefore, the physical as well as vital signs (§ 883).

678. During the healthy state of the vital properties all the results of life progress in one uniform way, according to the nature of the several parts of the organic being (§ 249). But, as soon as the properties of any part undergo changes there arise corresponding changes in the motions of the vessels, and in all the phenomena and products (§ 177).

679. Now it is owing to the insensible, recondite nature of the efficient causes of all phenomena that we are compelled to apply ourselves to the study of the phenomena to obtain a knowledge of the powers or properties upon which they depend, the modifications which the powers or properties may undergo, and the laws which they obey. It is obvious, therefore, that the nearer the phenomena are to the direct operation of the causes the more significant will they be of their nature and existing condition. This undeniable fact shows us the superiority of the primary effects of disease, as a guide to pathological conditions, over those ultimate results which are disclosed by morbid anatomy.

680. In entering upon this inductive branch of pathology it is important to bear in mind, that, however complex the nature and variety of symptoms they have always as much an absolute cause as any effect in the inorganic world; and I am led to this remark for the purpose of adding another,—that it is of incomparably greater importance to ascertain the former than the latter. When motions are disturbed in the subordinate kingdom it is the first impulse of reason to trace out the cause; but that is the measure of its compass. The Power

that gave to matter its being, or natural influences, can alone rectify the cause. But, how different with organic nature! How expressive of the radical distinction between the causes of motion in the dead and the living world! In the latter all is fluctuating in its nature, yet all controllable in that very nature by the hand of man. We see in the principle of life the cause of organic results. We see those results vacillating in every possible aspect; and, as with the chemist, or the astronomer, in the former case, we interrogate the cause. But we do so with a far higher aim; for we know that the cause is amenable to rectifying influences. In the world of matter and in the world of life the causes of erratic phenomena may be on a par in principle. The disturbing influences may be alike due to a common cause in each department, respectively. But, in the mineral kingdom there are numerous fundamental causes in operation, and the phenomena, therefore, may depend upon opposing influences. In the organic, from the mushroom to man, there is but one cause; and hence the obvious induction that certain changes in the natural condition of that one give rise to all those diversified effects which form the transient phenomena of disease, or those more stable changes which are seen in the progress of the being from its embryo to its adult state, or in the vicissitudes of temperament, &c.

We therefore apply ourselves, I say, to the cause itself; and here all analogy disappears with any known cause in the inorganic kingdom. The former is changeable in its nature, and as the changes go on, its existence comes to an end. But the same First Cause Who imparted that instability for great and wise purposes ordained, also, that when the principle of life should be diverted from its natural condition by untoward agents, it should still possess, through the same law of mutability, a capacity of receiving impressions from other agents that shall awaken its inherent tendency to a state of integrity.

In tracing out the nature and the seat of disease through the attendant phenomena, we are also animated with the conviction that organic beings are subject to laws as precise as those which rule in the inorganic world, under all their fluctuations; and the greater complexity in the elements of their laws than such as relate to physics and chemistry should stimulate the most exact investigation of symptoms wherever nature may demand the active interference of art, *so that the latter may make the best use of her laws* (§ 237, 447 *b*).

681, *a*. The symptoms, or effects to be employed as guides to the nature and seats of disease, are, 1st. Those which are denominated vital signs, and which are independent of physical products. 2d. The changes of motion and other conditions relating to the vessels which are the instruments of disease, but which are independent of structural changes. 3d. The physical products which are comprehended under the denominations of secretions and excretions. 4th. Symptoms of the foregoing nature which are determined or modified by changes of organization, and about which morbid anatomy is interested. 5th. Signs of a physical nature which depend upon either some change of structure, or on the accumulation of fluids, or the presence of some unusual fluid, or other substance, within the body. These last signs come to us principally through the medium of sound and touch. The first three of the foregoing classes of symptoms may be denominated *primary*, the last two *secondary*.

681, *b.* The five divisions into which I have distributed the symptoms of disease, and the remaining facts which we derive from morbid anatomy, and what we learn from remote causes, and the effects of remedial agents, supply all the knowledge we can obtain of the pathology of disease.

681, *c.* We must, therefore, constantly concern ourselves about effects, whether investigating the natural world, the powers by which it is governed, or spiritual existences.

Symptoms, then, are the language of disease, as effects are of all other real existences.

682, *a.* Certain symptoms are called *diagnostic.* By these, in part, we distinguish diseases from each other. A symptom, therefore, to be diagnostic, must be peculiar to one affection. Thus, hydrophobia is the diagnostic symptom of the disease which is called, like some other affections, after the name of its diagnostic. But it is only peculiar to the disease as it affects the human species. The diagnostic of intermittent fever is the intermission between the paroxysms; and so of their attendant intermittent apoplexies; and paroxysmal increase of those inflammations that are relieved by bark, and the intermission of periodical headaches, and of tic douloureux, are their diagnostics.

682, *b.* Some diseases may have several diagnostic symptoms. Thus, in pneumonia, a good diagnostic is found in the tenacity of the mucus. Another diagnostic is the crepitating noise which is heard on applying the ear to the chest. The first symptom, however, is often absent, and the other is not always present, especially in infants. The crepitus, also, disappears when condensation of the air-cells takes place, and this disappearance is diagnostic of condensation. But if the patient recover, the condensation generally disappears, and while the process of absorption is going on the crepitus returns, and this is diagnostic of the absorption. Many diagnostics are supplied by auscultation as to the particular parts which are affected in diseases of the heart, and which are significant of the precise nature of the affection. And so of the lungs. Percussion has also its peculiar diagnostic signs. We are doubtful, for instance, whether a tumid state of the abdomen be owing to flatulency or to something else. A hollow sound, on percussion, assures us that it depends, in part, at least, upon the presence of some gaseous substance.

682, *c.* Many diseases have certain symptoms which are nearly always present at certain stages of their progress, but are more or less attendant on some other affections. This is the case with the hectic fever of consumption. In such instances the other attending symptoms will determine whether the prevailing one in any particular affection is significant of that disease in the case before us. Incompressibility of the pulse is perhaps always significant of inflammation; but it often requires much skill to detect it. The attendant hardness of the pulse may be then taken as a good diagnostic; but this also is often ascertained only by a delicacy of touch, and may not be always distinguished from the pulse of pregnancy. An auxiliary diagnostic will then be found in a buffiness of the blood; but here, too, that appearance is often presented by the blood of pregnant females. There then remains an unequivocal diagnostic of inflammation in the associated cupping and fimbriated edges of the blood (§ 688, *d*, *e*)

On the other hand, there are many affections which have no diag-

nostic symptom; and we must then rely upon the combined symptoms, the remote causes, &c.

682, *d.* Such, then, are symptoms which impart a general apprehension of the nature of disease, or of its variations, &c. They serve as an aggregate of the other attending phenomena, and, in a general sense, should be employed only as starting points to a critical investigation of those numerous details which may alone conduct us to a knowledge of the extent and force of disease, its complications, &c.

683. There are other symptoms which are called *prognostic.* It is by these, in part, that we judge of the degree of danger, and of the probable issue of disease. Hence arise the terms *favorable* and *fatal*, and various other expressions of an intermediate import.

684. We acquire our knowledge of symptoms, or deviations from the natural states of the body, by comparing the former with the phenomena of the latter; and we distinguish diseases from each other, and learn the changes which are in progress, by comparing symptoms with each other. By the same system of comparison we judge, also, of the effects of remedies, form our prognosis, &c.

685. It is evident, therefore, that the young practitioner, at least, should acquire a habit of methodical analysis of disease, with a steady view to its pathological cause, and the successive changes which may arise in respect to this cause (§ 673, 675). He should begin,

1st. With an inquiry into the natural temperament of the subject, his age, habits, &c.

2d. Make a general survey of the symptoms, the organs from which they spring, their general aspect, number, variety, &c.

3d. In all cases of severity, the remote causes should be ascertained as far as possible.

4th. All the great organs should be next critically interrogated, that the primary seat of disease may be ascertained and understood, and how far it may have involved, by reflex nervous actions, other organs, both in their compound nature and in their individual tissues (§ 133, &c.), and how far, also, the sympathetic results may react upon the primary disease, or institute morbific reflex influences among themselves.

This inquiry embraces all the vital signs, the state of the secretions and excretions, and the physical signs afforded by auscultation and percussion. The countenance, the organs of sense, and all that relates to the external body, the state of the tongue, pulse, &c., should come under review.

5th. A careful comparison of all the symptoms should be instituted with the analogous phenomena in health; with the symptoms of the same disease as it may affect other parts; with the symptoms as they may have been observed in various degrees and at different stages of the same malady; with the symptoms of convalescence; and with such as follow the action of medicines; and with the symptoms of other diseases.

6th. Inquire into the mode in which the symptoms occur, whether suddenly or gradually, distinctly or confusedly, &c.

7th. Consider their progress, their changes, the mode of their progress, &c.

8th. Examine the relation of different symptoms to each other; as, their relative duration, order of occurrence, &c.

9th. Calculate the degree or force of the symptoms; a point of difficult attainment, requiring a correct appreciation of the properties of life, a profound knowledge of physiology, an extensive acquaintance with its modifications in disease, habits of a close analysis of symptoms, much thought, and a well-disciplined mind. To one thus qualified the eye of the patient alone may be a luminous index to the degree or force of the general symptoms (§ 163, 714).

686, *a*. And now, as a consummation, next to the direct application of remedies, of all that has been hitherto submitted to my reader, as immediately indispensable to the ultimate aim of all that has been said, and without which the Institutes of Medicine would only serve as an intellectual exercise, I shall introduce a practical example, as a general standard for investigating any given form of disease with a view to its treatment (§ 714).

686, *b*. Let us, then, suppose ourselves called to a case of idiopathic fever of some three or four days' duration, in which, from the length of its continuance, there have probably arisen some local inflammations, and, perhaps, venous congestions.

We proceed, according to the foregoing method (§ 685), to inquire,

1st. Into some general facts, and take a general survey of the case. We inquire how long the patient has been sick, with what symptoms he was attacked, what new ones have subsequently sprung up, whether they have undergone an increase in the afternoon, and a decline toward morning, whether the attack was preceded by unusual sensations, or by any signs of beginning disease, what is his age, constitution, habits, &c. The knowledge thus acquired gives us a general apprehension of the nature of the case, and we come, at once, to the conclusion, that it is a case of idiopathic fever, affecting an individual of a certain age, temperament, habits, &c. This leads us to inquire,

2d. Into the nature of the predisposing causes (§ 662), and as they are atmospheric (§ 648, *b*), we ascertain his place of residence for a few preceding months. We find, perhaps, that he has lately come from a city where yellow fever prevailed, or had resided from one to six months ago where typhus was rife, or where it is known to occur, or from one to twelve months since he had been in some marshy district, or upon some new rich soil, where the remittent fever delights; or, there may be reason to suppose that the causes originated in the place where he is attacked. A knowledge of any of these facts, whichever may be true, goes far in ascertaining the particular modification of fever he may suffer (§ 650–653). Let us suppose him an Irish emigrant, just landed in New York. We suspect at once typhus fever, though we have no such fever originating with us.* It is a very common form of fever, however, in Ireland; and we learn farther from our patient that it prevailed in his neighborhood when he left that country. This knowledge influences our subsequent inquiries, when we proceed,

3d. To inquire specifically into the symptoms attendant on all the organs, and to compare them with the natural phenomena of each. We begin where they are most strongly pronounced, and pass from one organ to another as may be suggested by the most obvious symptoms, or as they may seem to be related by sympathetic influences (§ 660). The disease being typhus, the brain, or its membranes, are probably the seat of inflammation or venous congestion. We inquire

* See NOTE S p. 1124.

as to headache, whether obtuse or acute, in what part of the head, &c.; whether there be drowsiness or wakefulness; whether there be an unusual pulsation of the carotids, or of the temporal arteries, or an exalted temperature of the head; whether the face be suffused with blood, and if so, whether the plethora be in the arteries or veins,—being florid in one case and purplish in the other. We look critically at the eyes, observe how their lustre or other expression is affected; whether the pupil be dilated or contracted, and, if the sight be dim, we inquire whether it be owing to an affection of the retina, or how far to actual cerebral disease or to sympathy of the eyes with any gastro-intestinal derangement; whether the conjunctiva or the eyelids be red or purplish, whether moist or dry, &c. We attend to the hearing, whether dull or acute; observe how far speech may be affected, and how much any impediment may be due to cerebral disease, or to dryness of the mouth, or to inattention, &c. These inquiries relative to the senses should be accompanied by others respecting the mind, whether memory be much affected, perception and reflection impaired, whether there be hallucinations when awake, or talking in sleep, and whether sleep be comatose, or how long continued, &c. These inquiries may leave little doubt that there is both inflammation and venous congestion within the head, which will be cleared up by an investigation of symptoms relative to other organs (§ 803, &c.). Our attention may be next attracted to the chest by cough, or some embarrassment of respiration. We inquire when the cough began, what its frequency and severity, how far it may be independent, in its origin, of other local burdens of disease, or how far consequent on abdominal affections, and whether attended by expectoration, and what the nature of the matter expectorated. We count the respirations, and observe their equality or inequality. We see, perhaps, that the brain influences the respiration unfavorably, especially if slow, and this adds to our conviction that mischief exists in the head; or, if the breathing be hurried, it may be due to febrile excitement, or to abdominal derangement. The cough and expectoration show us that some inflammatory action is going on in the lungs; but we are doubtful, perhaps, on account of some thoracic pain, and as the sputa is rather adhesive, whether inflammation be confined to the mucous membrane of the bronchi, or have reached the air-cells and cellular tissue, and thus constituting pneumonia. We therefore resort to auscultation and percussion to resolve the doubt. From the former we learn that there is no crepitus, that the murmur is clear and free, and there is only a mucous râle; by percussion, we find that the resonance is good, and we therefore dismiss our fears as to the possible existence of pneumonia, or of tubercle. But the patient complains of pain in his chest. We ask him to breathe deeply, and the pain is much increased, as it is also on coughing. From this symptom, and the absence of pneumonia, we are sure of the existence of inflammation in the pleura, while the cough and expectoration tell us of catarrhal inflammation in the pulmonary mucous tissue.

It is now time to feel of the pulse, to learn how far reflex nervous actions may affect the heart and arteries, since the extent of the influences on the circulatory organs may show us considerably the severity of the local inflammations. But this system is also under the influence of the general idiopathic disease, and it is often one of the nicest

points to determine how much of its character is due to the febrile affection and how much to reflex nervous actions. And the difficulty is enhanced if influences are directly propagated abroad by cerebral disease. We find the pulse, perhaps, not so hard or full as we had expected, and this leads us to infer more of venous congestion than of ordinary inflammation of the brain; or, that there may be venous congestion in some other organ not yet examined, since these congestions are very apt to spring up in typhus, and to moderate a hardness of the pulse which the coexisting inflammations of the membranes of the brain and lungs would otherwise produce (§ 815, &c.). Perhaps we discover, also, in the pulse, some intermission or other irregularity in its stroke. This may be owing to some organic affection of the heart, and to resolve this doubt, we again resort to auscultation. We find, however, all the sounds good, and we are now led by the foregoing symptom, along with the subdued hardness of the pulse, and its want of any great incompressibility, to suspect venous congestion of the liver, since intermission and other irregularities of the pulse, without organic disease of the heart, commonly depend upon that state of hepatic disease, though, also, on cerebral inflammation; but in the latter the pulse is more frequent than in the former case, when, also, in the absence of fever, it is often preternaturally slow; or, if slowness of pulse depend on venous congestion of the brain, as it sometimes does, the respiration is also apt to be slow, while it is unaffected in simple hepatic congestion (§ 390, *b*). We then take the liver next in our range of inquiry. We find, perhaps, some obscure tenderness on pressing its region, and the patient may have had some pain in this quarter. We then look at the skin, to see whether there be any shade of yellow, and when our cathartics operate, we examine the discharges with various references, but particularly as to the state of the visceral secretions. If they are blackish, or green, this strengthens our conclusion as to congestion of the liver, though the congestion may be so profound that little or no bile is secreted. This condition of the liver, however, is more apt to attend remittent, intermittent, and yellow fevers. We observe whether there be a redundancy of intestinal mucus, as this would denote some inflammation of the mucous tissue, and has often an important bearing upon the treatment of the case, as does also that irritable state of the intestine which is denoted by the diarrhœa that often supervenes in the progress of typhus fever. We look at the urine, and find it perhaps scanty, scalding, very high-colored, and depositing a sediment. This, however, would imply nothing distinctly, but that the kidneys suffer in their powers and functions, though great scantiness of urine and a high color would denote a considerable burden of disease upon one or more important remote organs, and those particularly the digestive organs. We now turn our attention more particularly to the alimentary canal, partly with a reference to its morbid state, and in part to aid our judgment in the right administration of medicines. Here, too, we may find a great focus of disturbing reflex nervous influences radiating from the gastro-intestinal mucous membrane, lighting up inflammations or congestions of other parts, or maintaining and aggravating such as may have sprung from other causes, and sustaining itself reverberated nervous influences (§ 514 *h*, 647, 889 *g*). We press, for example, the region of the stomach, to learn whether it be

tender, and in like manner examine the whole, or special regions, of the abdomen, if there be pain or uneasiness in the intestines, &c., and we make percussion to see if there be flatulency. We inquire what food the patient has recently taken, and whether the bowels have been constipated or loose. In all this part of the inquiry we are often greatly aided by the appearances of the intestinal evacuations, which should be carefully observed throughout the continuance of disease (§ 694½). We also examine the tongue with a reference to several objects, but especially with a view to the condition of the stomach and intestines. We notice its color at its edges and in the centre; whether coated, and how extensively, and what the color of the coating in its different parts; whether light and loose, smooth or rough; whether dry or moist, and the extent of each; whether the tongue be enlarged or contracted, pointed or obtuse, smooth or indented at its edges, what its color, &c. We look at the fauces, to learn if they be red or purplish, as indicative of inflammation or venous congestion, or other derangement in the important organs below; observe whether there be glutinous matter on the teeth, and what its color, and the rapidity with which it may collect.

We now turn our attention more distinctly than before to the functions of the skin; whether it be dry or moist, or each alternately, and the duration of each, whether hot, warm, or cold, and at what times, and how long, whether the heat be distributed equally, whether the feet be cold when the rest of the surface is hot, whether the skin be rough or smooth, what its color, whether there be "sudamina," "rose-colored spots,"* &c.

The patient may require the loss of blood, and we observe its color, whether dark or florid, the manner in which it flows from the arm, whether in a full stream or whether it trickle, whether it throw up a buffy coat, be indented or cupped in its centre, or fimbriated at its edges; and, that these observations may be perfect, we take an ounce in a funnel-shaped vessel for examination (§ 682 *c*, 688 *ee*).

If, in the case of fever now under examination, there be a predominating influence of the venous congestions over the membranous inflammations, the blood will be dark, will trickle from the arm, or flow in a languid stream, at first, and will throw up a buffy coat, without as much indentation as when membranous inflammation exists without venous congestion.

686, *c*. The foregoing analysis of symptoms is, to the young practitioner, necessary to a clear apprehension of many severe diseases, but must be more or less varied according to the nature of the disease. It may be apparently tedious, but is accomplished with rapidity by a little practice. Nor have I stated all the inquiries which should have been instituted, and which may be of essential moment. Thus, it may be necessary to call in the aid of smell to ascertain whether any fœtor we may observe come from the mouth, or stomach, or lungs, or from the surface of the body. The patient may also supply a variety of facts as to his sensations,—whether restless, weary, prostrated in his voluntary muscles, what as to pain, or sensations of heat, chilliness, &c. We vary his posture, to learn how it may affect respiration, or the state of his pulse. I have also left out of my examination of the

* See Essay on the Writings of Louis, in *Medical and Physiological Commentaries*, vol. ii. p. 724, &c.

foregoing case an inquiry as to the mode in which the symptoms took place,—whether suddenly or gradually, distinctly or confusedly, whether they began with a chill, or with a paroxysm of heat, &c., about which the patient should be specifically interrogated. Nor did I examine sufficiently the relation of the different symptoms to each other, as their relative duration, their order of occurrence, &c., by which we ascertain which organ was first inflamed or congested, and what others are more or less affected by reflex nervous action. And there yet remains to be considered the progress of the symptoms, their mode of progress, their spontaneous changes, or such as may arise from incidental exciting causes, or from the action of remedies, &c., and, also, their comparison with those of other modifications of fever, or other forms of disease. I said nothing, specifically, as to an inquiry into the degree or force of the symptoms, which is always a subject for accurate consideration, as it goes far in denoting the severity of disease in different parts, and is one important guide to the nature and extent of the remedies. But this is an attainment, as already implied, which cannot be imparted by a description of symptoms, since their force cannot be expressed in language. Their estimate must come, as it were, by intuition. CHEMISTRY *contributes nothing.*

686, *d.* In proportion as our knowledge of physiology enlarges, and we apply it to the investigation of disease, the practice of a minute analysis of symptoms becomes less and less necessary. But, to acquire this professional tact or skill, we must first go through the school of elementary instruction and practice. But industry will at last triumph, and what seemed at first obscure in diseases may become luminous at a comparatively superficial view. We then begin to neglect, more or less, many of the minutiæ. We confine ourselves more to the most prominent or characteristic symptoms. The countenance alone may tell us of a labyrinth of disease. But, it will still often happen that no prominent symptoms are present, and it may then be necessary to go into the details; or they may be so confused and indistinct as to render us undecided as to the seat or the nature of the disease till other symptoms are developed. This may be illustrated by the growth of a plant. When it first emerges from the ground it may have no specific characters by which we can determine whether it be destined for a tree or a weed. We must therefore await the development of its characters, which, if it continue to grow, it will certainly put forth. There is often an obscurity of a like nature in diseases, at their early invasion, and even when profound. The soundest judgment may be baffled in the adaptation of certain remedies; and if these are to be administered internally, especially if active, no risk should be taken, but farther developments awaited.

OF CERTAIN SPECIAL SYMPTOMS.

687. It had been my purpose to have limited my remarks to the general principles which respect the present branch of my inquiries. But, in consideration of what I shall say of the pathology and treatment of inflammation, venous congestion, and fever, as also on the subject of bloodletting, I have determined to express my own views as to some of the symptoms which take a prominent rank in diseases. It is also my desire to associate the results of disease with the philosophy which concerns them, that these important sources of pathological

knowledge may be studied in connection with those inquiries which distinguish the philosophical physician from the mere empyric (5½, *a*).

The Pulse.

687½. There is one system of organs, particularly, whose motions are so constantly affected by reflex nervous actions, and whose phenomena are universally employed in estimating the nature, force, &c., of all diseases, and at all stages of their progress, and which are also elementary in denoting the effects of remedies, especially of loss of blood, that I shall make a general analysis of the prominent characteristics. We generally learn the influences exerted upon this system of organs by the varying states of the *pulse*, and the radial artery affords the best opportunity for this purpose, though the pulse may be often advantageously examined in other places. Thus, in inflammations and congestions of the brain it is useful to learn how far the pulsation of the carotids may be specifically affected. So, in similar affections of the liver we attend to any unusual pulsation of the aorta in the region of the stomach. In all such cases irritations are apt to be propagated by continuous sympathy along the principal communicating arteries, by which their action is more or less increased (§ 498). It may be also important, sometimes, to examine the heart itself, especially when it may be suspected of being the seat of absolute disease; and, although the pulse be generally regulated by the action of the heart, the arteries, as we have now and before seen, are liable to independent influences, arising from reflex nervous action, and from continuous sympathy. As to the latter, if there be inflammation of the hand or arm, we shall be very likely to find the pulse on that side with greater characteristics of disease than on the other; and differences will arise from mere differences in the size of the arteries. In inflammations and congestions of the brain, the nervous influence will often exert an effect, less marked in similar affections of other organs, upon the capillary vessels, and this effect is sometimes strongly pronounced by an inequality in the radial arteries (§ 929–936, 973, 974). In various forms of disease the heart sometimes beats with greater force than is denoted by the pulse at the wrist, and sometimes the pulse is very voluminous without a corresponding action of the heart, according to the nature of reflected nervous actions.—Note Ll.

688, *a*. When the radial pulse is examined, the four fingers should be applied along the course of the artery, and various degrees of pressure should be made. The blood taken for examination should be into a conical wine-glass, and, if possible, in a full stream.

688, *b*. Certain general conditions of the pulse worth noticing are the following :—its *quickness*, *slowness*, *frequency*, *hardness*, *softness*, *incompressibility*, *compressibility*, *fullness*, *smallness*, *strength*, *weakness*, *obstruction*, *freedom*, *intermission*, *redoubling*, *trembling*, and *other inequalities* (See an extensive application of all this in § 500 *m*, 694¾, 826 *cc*).

688, *c*. *Quickness*.—This term does not stand in opposition to *slowness*, although it is generally so considered. *Frequency* is the opposite of *slowness*. Quickness arises from the systole of the heart occupying less time than its diastole; so that a *quick* may be a *slow* pulse. The stroke is then sudden, the dilatation more prolonged, with an interval somewhat distinct. A *frequent* pulse, on the contrary, is always what the term denotes. The systole and diastole of the heart succeed each other rapidly, and in about equal times.

A *slow* pulse is, also, like a *frequent* one, uniform as it respects the systole and diastole, both of which are prolonged. It is most apt to be attendant on chronic venous congestions, though, as the affection advances, or undergoes any sudden increase, it may become *frequent*. When *slow* in such conditions, the pulse is also often intermittent or otherwise irregular, and if it subsequently become frequent, the irregularities are apt to disappear. Venous congestion is always to be suspected, and especially in the liver, when the pulse is preternaturally slow, without other manifest signs of disease (§ 390, *b*).

Quickness of pulse is not an important symptom, in a general sense.

688, *d*. *Hardness* and *Softness*.—These terms stand in opposition to each other. *Softness* is a natural state, and *hardness* a morbid one; though a pulse may be preternaturally *soft*. *Hardness* of pulse is one of its most important modifications. In nearly all cases it is indicative of inflammation, and no considerable inflammation can exist long without producing it. It appears to depend upon some direct modification of the action of the vessels, and not connected with that of the heart; the nervous influence being determined in a peculiar manner, by inflammatory affections, upon the whole arterial system (§ 226, 233, 973, &c.). The term *hardness* may be well understood by comparing the sensation to that which is produced by a solid rod rising simultaneously, and not successively, against the four fingers.

688, *dd*. *Hardness* is often confounded with *strength* and *fullness;* but the three symptoms are very different from each other. A *hard* pulse is perfectly compatible with *smallness* and *weakness;* the former of which is seen especially in peritoneal inflammation of the intestine, and in pulmonary consumption; the latter in unsubdued inflammations after repeated abstractions of blood, and often in congestive fevers, and in phlebitis. To distinguish the *hardness* fully, in these latter cases, requires a careful regulation of the pressure; scarcely more than a gentle touch with the four fingers. Greater pressure may extinguish the symptom, and the pulse may even appear to be soft. The distinction is often of great importance, especially in congestive diseases, as upon it may depend the decision of those who are apt to be governed by the state of the pulse in the important matter of bloodletting (§ 961–965, 971).—Note Ll p. 1140.

688, *e*. *Compressibility* and *Incompressibility*.—*Incompressibility* of pulse is probably peculiar to inflammatory conditions, and one of the most uniform characteristics of the pulse when such conditions disturb the general circulatory system by reflex nervous actions. But when inflammation is fully overcome, especially if general bloodletting have been freely practiced, the pulse is often more easily compressed than in health. So long, however, as the disease continues to affect the general circulatory system, that peculiar characteristic remains, in various degrees, unless the remedies be very depressing, or the powers of life verging toward a state of extinction. But, as might be expected from what I have said of *hardness* of pulse in venous congestions, *incompressibility* is less marked in all forms of venous inflammation than in equal conditions of inflammation of other tissues. Here, too, as with *hardness* of pulse, the observer is very liable to be deceived; since the general volume of the pulse may give way under a slight pressure, and yet the pulse be incompressible (§ 688, *d*).

The proper method of ascertaining this symptom, in doubtful cases,

is to make a hard pressure with one finger, and a moderate pressure with another on the distant side, when a thread-like stream will be felt by that finger. It depends upon reflected nervous influence.

Hardness and *incompressibility* generally demand the loss of blood; though whether local or general, and the necessary extent, must be determined by other symptoms; the extent, especially, by the effects produced during the operation of general bloodletting (§ 826 *cc*).

688, *ee*. Coincident with *hardness* and *incompressibility* of pulse, and almost peculiar to inflammation, is the *buffy coat*, with its depressed centre, and often fimbriated edges. The buff which forms on the blood in pregnancy is due to the increased vascular action of the uterus, and a modification of its vital properties not very dissimilar to what obtains in some varieties of inflammation, and which predisposes to those active forms of the disease which so often beset the uterus and other parts in the early stages of childbed; and should the indented centre and fimbriated edge make their appearance, we shall scarcely fail of deriving farther confirmation of the actual presence of inflammation in an attendant hardness and incompressibility of the pulse, and probably, also, in some local symptoms. And so of the buff which is sometimes apparently consequent on violent exercise; but more probably dependent upon some obscure inflammation. We may not trust, in these rare instances, to the carelessness of many observers, and the incapacity of others, while the fact should not be neglected that this exception to a significant indication for loss of blood has been raised by such as are adverse to the use of the lancet in the treatment of inflammation (§ 826 *cc*, 952, 1020–1024).

The indentation, or cupping, is generally less strongly pronounced after each abstraction of blood, and may disappear altogether, under the lancet, before the inflammation is subdued (§ 952 *b*).

The fimbriated edge is most common where inflammation is severe, and has established a strong reflex nervous action upon the general circulatory system. In such cases, also, it will often continue to occur after the cupping ceases to be formed.

Like hardness and incompressibility of the pulse, the buffing and cupping of blood, for reasons already stated, are less strongly marked in venous congestions than in membranous inflammations.

The formation of the buff, and the central depression, and the fimbriated edge, are remarkably affected by the shape of the vessel, and by the manner in which the blood flows from the veins. A shallow vessel is the worst, the form of a funnel is the best.

688, *f*. *Fullness* and *Smallness* of pulse.—These terms are also in opposition, and both may imply a preternatural state of the pulse, being now employed in their morbid acceptations. *Fullness* is also synonymous with *largeness*.

These morbid states of the pulse are owing to reflex nervous actions determined both upon the heart and arteries. The extent of these influences, in that respect, is very variable, and must be judged of by direct examination of the pulse at the heart and extremities.

It does not necessarily follow that an unusual quantity of blood is sent out by the heart, since the volume of the arteries may depend greatly upon a direct expansion of the vessels. So in a small pulse, the direct morbid influences may be more upon the arteries than upon the heart, by which the vessels are held in a contracted state.

This is especially seen in the cold stage of fever, and in peritoneal enteritis. It is also seen in the depressing states of venous congestion. In all such cases an influence is propagated from the arteries to the heart, by which, as well as by other influences, its action is accelerated; or, if not accelerated, then the blood accumulates in the venous system, especially about the right cavities of the heart. In all these cases there are profound reflex nervous actions well worthy an inquiring mind (§ 222, &c., 514 *d*, *k*, *l*, 914–919, 929–936, 973, 974).

Smallness of pulse is generally a much more important symptom than *fullness;* commonly implying the presence of greater evil. Connected with hardness, it is always bad, when it is also *frequent.*

688, *g. Strength* and *Weakness.*—I have already remarked that these symptoms are often mistaken for *hardness* and *softness.* They depend, principally, upon reflex nervous actions that are exerted upon the heart by remote organs, though certainly not altogether. It is doubtful, indeed, whether morbid reflex nervous actions are ever exerted upon the heart without being simultaneously extended, more or less, to the arteries; especially to the capillary series (§ 481–485, 973, 974). But, all parts of any one division of the arterial system may not be equally affected, or one part may be sensibly affected and not the rest, as in blushing, when the nervous influence is direct.

688, *h. Obstruction* and *Freedom.*—*Obstruction* is an obscure condition of the pulse which it is difficult to describe, but is recognized in practice. It is not easy to know its cause, as it probably does not actually arise from any obstacle to the passage of the blood, though it may be owing to a want of harmony between the action of the heart and the capillary blood-vessels (§ 386).

688, *i. Frequency* and *Slowness.*—These are two very important symptoms in some of their morbid aspects, and are often replete with information, especially as to the force of disease and the degree of danger.

To ascertain these characters, the patient, for obvious reasons, should be at rest; and if a child, should be asleep.

No writer has so well described the conclusions to be derived from a *frequent* and *slow* pulse as Dr. Heberden, in his "Commentaries." From their importance, and as I cannot improve Heberden's description, I shall quote it.

"The pulse of a healthy infant asleep," he says, "on the day of its birth, is between 130 and 140 in a minute; and the mean rate of the first month is 120. I have never found it beat slower than 108. During the first year, the limits may be fixed at 108 and 120. For the second year at 90 and 108. For the third year at 80 and 100. The same will very nearly serve for the fourth, fifth, and sixth years. In the seventh year the pulsations will be sometimes so few as 72, though generally more; and in the twelfth year they will often be not more than 70; and, therefore (except only that they are much more easily quickened by illness, or any other cause), they will differ but little from the healthy pulse of an adult, the range of which is from a little below 60 to a little above 80. It must be remembered that the pulse becomes more frequent, by 10 or 12 in a minute, after a full meal. [Müller, remarkably, states the same rates].

"If the pulse either of a child, or an adult, be quickened so as to

exceed the utmost healthy limit by 10 in a minute, it is an indication of some little disorder. But a child is so irritable, that, during the first year, a very slight fever will make the artery beat 140 times, and it may beat even 160 times without danger [Heberden meaning either idiopathic fever, or the constitutional effects of inflammation]; and, as there begins to be some difficulty in counting the pulse when the motion is so rapid, the thirst, quickness of breathing, aversion to food, and, above all, the want of sleep, enable us, better than the pulse, to judge of the degree of disease in infants.

"If the pulse of a child be 15 or 20 below the lowest limit of the natural standard, and there be, at the same time, signs of a considerable illness, it is a certain indication that the brain is affected, and consequently such a quiet pulse, instead of giving us hope, should alarm us with the probability of imminent danger.

[An important exception to the foregoing remark is frequently presented by venous congestions of the liver, when the pulse may be equally diminished in frequency, but not indicative of present danger.]

"In adults ill of an inflammatory fever, the danger is generally not very great where the beats are fewer than 100;—120 shows the beginning of danger; and they seldom exceed this number unattended with some deliriousness. There are two exceptions to this observation. The first is, that before some critical swelling or deposit of matter begins to show itself in fevers, the pulse may be so rapid and indistinct, as hardly to admit of being counted; and I have known it certainly not less than 130, and yet the patient has recovered. And rheumatism affords a second exception; in which the artery will often beat above 120 times without any sort of danger.

[Those exceptions are relative to inflammation as limited to parts unimportant to organic life. They are presented, also, in other instances of this nature, and in intermittent fever.]

"In an illness where the pulse all at once becomes quiet, from being much accelerated, while all the other bad signs are aggravated, it is a proof, not of a decrease of the disorder, but of the lessened irritability of the patient, and that the brain has become involved in the disease.

"In low fevers, and in exhausted old men, the pulse will often continue below 100, or even 90, and yet the disease be attended with want of sleep, deliriousness, restlessness, and a parched tongue, and end in death, without any comatose or lethargic appearances.

"A pulse increased in frequency more certainly denotes danger than a natural one does security, where disorders of the viscera are suspected."

Finally, in countries where local congestions of the liver occur, as in the regions of intermittent and remittent fever, the pulse often falls, in hepatic congestions, far below its natural frequency. Considered abstractedly in these cases, and often in the preceding, it affords but little information as to the force of disease. There may be great danger, or but very little, when the pulse is slow in hepatic congestions, and all other symptoms obscurely marked; but if the slowness be supported by restlessness, sighing, thirst, wakefulness, &c., the danger is great.

A good pulse, excepting a moderate hardness, and incompressibility, as sometimes happens in pneumonia, may be attended with great

danger, which can only be inferred from other symptoms. Indeed, I may say in a universal sense, that the state of the pulse alone should rarely guide our conclusions, either as to the force of disease, or its treatment. The circulatory organs are so readily and variously disturbed by the nervous influence, and that influence so constantly generated by physical and mental causes, that disease offers but few opportunities when the pulse may be safely trusted for the just application of remedies without the support of other symptoms (§ 826 *cc*, 829).*

688, *k*. *Intermission.*—An intermitting pulse arises from an abrupt suspension of a pulsation of the heart. It is not an alarming symptom, unless it depend upon some organic affection of the heart, or some disease of the brain. It is a frequent attendant upon venous congestions of the liver, and often presents itself for the first time after the patient becomes convalescent, and may continue till the flesh and strength are restored. It is most apt to appear when the pulse is also preternaturally slow, and frequently vanishes temporarily if the circulation happen to be accelerated by transient causes, or a great irregularity of the pulse may be the temporary consequence. Its philosophy is explained in a foregoing section (§ 390, *b*).

688, *l*. *Irregularities* of pulse.—These consist of irregularities in its successive beats, redoublings, trembling, hobbling, &c., and are rarely of much importance unless proceeding, as in cases of intermission, from organic affections of the heart, or disease of the brain.

The Tongue.

689, *a*. We will now turn a brief attention to the morbid appearances of the tongue. It is by these, and the secreted products, that we obtain our most direct intelligence from the internal viscera, though other less sensible results may be more significant of the nature and force of disease.

689, *b*. The tongue is covered by a secreting membrane, whose action is liable to great and various changes, and which are attended by visible results. In its healthy state this membrane is covered by a thin fluid, which is partly composed of its own mucous product, and, in part, of saliva. The natural color of the tongue is a light florid hue, and it is studded with short minute papillæ, particularly at its edges. In disease these appearances are apt to undergo various changes; the tongue being often covered more or less extensively with a coat of variable hues, white, yellow, brown, or black, barely attached, or closely adherent, rough or smooth, &c. At other times the organ is preternaturally red or livid, dry or moist, enlarged or contracted, pointed or obtuse, its natural coat thickened or apparently scraped off, or covered with patches, vermiform marks, &c., its edges jagged, the papillæ enlarged and elevated, &c. These conditions depend upon various modifications of the organic functions of the tongue; and as the organ is not much liable to independent disease, it is obvious that its morbid aspects are mostly sympathetic results; and from its being continuous with the alimentary canal and the lungs, morbific influences are readily propagated upon it from either of its remote connections (*i*). But, the vital relations of the tongue to the alimentary canal are far greater than to the lungs, though not strongly pronounced in health; and as intestinal derangements are more common than pulmonary, a far greater proportion of

* Note Ll p. 1140.

the morbid and intense influences from these two sources are exerted by abdominal disease (§ 129 *i*, 135, 142).—See INDEX II, Art. *Tongue.*

689, *c.* The coating which forms upon the tongue may consist mostly of mucus, or of a substance resembling coagulable lymph, or intermixtures of both, in various proportions, and of a morbid character.

689, *d.* All the phases which the tongue is liable to undergo may be influenced by the peculiar constitution of the patient, though in a general sense, where the constitution is sound, these appearances are less subject to the contingencies of temperament than many other symptoms.

689, *e.* We often observe, under various circumstances of disease, that the coating has suddenly disappeared, and we may be led into error in consequence, since, in many of these cases, the coating has been removed by the mechanical friction of food.

689, *f.* It would be in vain to attempt a definition of the various changes in the aspect of the tongue which are produced by disease, according to its nature and seat, accidental causes, &c. The appearances may vary much under apparently the same conditions; and it is not one symptom alone which may attend the tongue, but the whole in combination, that must guide our judgment. It is important, also, to observe that the tongue may be very natural in profound diseases, even of the alimentary canal and liver; but as observation enlarges, and the depths of physiology are explored, we shall find the morbid signs of the tongue a luminous index of disease.

689, *g.* But, there is one remark more important than the rest; namely, that there are no other symptoms which borrow so much light from others as those which relate to the tongue; while, in their turn, they reflect back a light upon the other symptoms. Inflammations of various parts, and idiopathic fevers, at their onset may present nearly the same appearance of that organ, especially as it regards the coating. The general symptoms now contribute largely in determining the import of the tongue; though we shall generally find, on close inspection, that not only each class of diseases will offer certain peculiarities in the morbid aspects of the tongue, but as inflammation may affect one important organ or another; and the appearances will vary in the early stages of idiopathic fever as the burden of disease may happen to be distributed. In the progress of the same affections, the tongue is continually fluctuating in the indications it may supply.

689, *h.* The disappearance of the coating in fevers and inflammations generally begins at the edges of the tongue, and is commonly indicative of an improvement of health, though not always. When these exceptions occur some other morbid appearance is apt to follow immediately; as preternatural redness, or nakedness, or dryness, &c. If indicative of improvement the tongue commonly clears up fast, along with other auspicious changes; though it will be frequently kept up, more or less, by remaining though slight visceral derangements in the abdomen.

689, *i.* Absolute diseases of the digestive organs affect the tongue more variously and distinctly than other parts; according to their nature, seat, intensity, duration, peculiarities of constitution, habits, &c. (§ 129 *i*, 142). In indolent affections of the stomach, a thick, dirty, yellow coat, easily scraped off in part, appears particularly

toward the root of the tongue; when, also, the tongue often becomes furrowed, or covered with patches of various forms, indented at its edges, or apthæ arise; the coat, too, varying according to the varying states of the intestinal canal, or of the liver, &c.

689, *k*. If the tongue be very red, it denotes more or less active inflammation of some part of the intestinal mucous tissue; and if also dry, and especially if at the same time denuded, it shows inflammation of greater intensity in that membrane. A tongue preternaturally naked, even if moist, and of no great redness, shows moderate or sub-inflammation of the mucous tract; probably of the small intestine. A livid tongue shows venous congestion of the alimentary mucous membrane, and probably also of the liver. It is always indicative of formidable disease.—See INDEX II, Art. *Tongue, Heart, Kidney, Pulse.*

689, *l*. In connection with the foregoing subject I may advert to an inflammatory state of the mucous tissue of the fauces which ensues upon congestive affections of the chylopoietic viscera, and which is too often regarded as an independent disease, and treated accordingly. But, the condition of which I speak is so comparatively unimportant with the primary affection upon which it depends, and is so often significant of the force of obscure, but dangerous forms of abdominal congestion, especially of the liver and intestinal mucous tissue, that I would rather place it among the symptoms than designate it, in its true character, as a sympathetic form of disease. This inflammatory affection is commonly of an erysipelatous nature, attended by more or less tumefaction of the tissue, and often of the tonsils. It varies greatly in intensity, and presents different hues from bright scarlet to livid; the latter being the worst, and denoting a profound and dangerous modification of venous congestion (§ 813–816). In its worst forms, the throat is quite liable to ulceration, and often to sloughing. In the latter case it is commonly denominated the "putrid sore throat," and, most unhappily, this symptom, as it were, has been extensively regarded as the main disease. These appearances of the throat are also a common attendant on bad forms of scarlatina, and are due to profound congestion of the liver and intestinal mucous tissue, associated, more or less, with a peculiarly modified form of inflammation of the same tissue (§ 803, 816 *b*). The whole of this secondary evil is, abstractedly, of little comparative moment, and is analogous in its import to those forms of erysipelas which affect the surface when this symptom is epidemic (§ 463 *a*, 523, no. 7, 630 *e*, 713, 961 *a*, 970 *c*).*

Secretions and Excretions.

690. The secreted and excreted products, which fall under the cognizance of the practitioner, are messengers of intelligence either directly from the citadel of disease, or from organs which participate sympathetically with affections of other parts, or which may scarcely do more than minister to the general wants of the body. They are, therefore, to be received according to their several degrees of importance. They consist of urine, sweat, mucus, and the alvine discharges.

691. *The Urine.*—No product is so variable as the urine, both in health and disease. The kidneys, being designed for great and immediate common purposes in the animal economy, in depurating the blood, or in transiently fulfilling the office of the skin, &c., are rendered highly sensitive to the presence of redundances in the blood, and

* Such, also, is equally true of the various phases of Bretonneau's DIPHTHERIA, and which is generally considered a local or a humoral affection.—NOTE Kk p. 1140.

to the variable states of other parts, especially of the skin, whose analogous office is so liable to interruption. The same Great Intelligence, which ordained these final causes, also endowed the kidneys with a stability of function unknown to other parts (excepting the heart, for a like principle), where irritability is easily impressed. Being, therefore, but little subject to actual disease, the variable product of the kidneys commonly supplies only a report of the nature of the ingesta, or of the influences which the skin or other parts, and even the mind, may exert upon these organs in a healthy state, or of the mutable states of the body in regard to nutrition, or of any disturbing reflex influences, short of disease, which may be extended to the kidneys by diseases of other parts (§ 426). It is thence obvious, that but little dependence, in a general sense, can be placed upon the sensible changes of the urine as indicative of the nature or force of disease; and I have endeavored to show, here and elsewhere, that we may rarely trust to chemical analyses of this product (§ 417, 427). Beyond a transient inspection, occasional evaporation is about all that we require, unless, also, some practicable test in calculous affections. The aspects of the urine become more important in renal diseases, and in those of the bladder. Albuminous urine appears in organic affections of the kidneys, in dropsy, and after pastry and other indigestible food, and is produced by mercury and cantharides. It is evident, therefore, that the presence of albumen, about which so much has been written, indicates nothing specifically, unless supported by other symptoms (§ 421–427. Also, *Medical and Physiological Commentaries*, vol. i., p. 674–682).—*Vide* LEHMANN, p. 780.

A sensation like that of *strangury* is often felt when the urine is high-colored and scanty. This is commonly owing to abdominal disease; particularly hepatic congestion.

692, *a*. *Sweat.*—The perspirable matter is the least important of any of the tangible products of disease, unless as it respects the amount of sweat in its connection with the other attending symptoms, or as significant of the effects of certain remedial agents. Not much can be inferred from its quality, and this little is gathered from its taste and odor. Dryness of the skin is oftener an important character; and it is usually one of the best signs supplied by the skin when its dryness yields spontaneously. Perspiration induced by medicine is of little moment, unless the remedy simultaneously impresses, directly or indirectly, the parts diseased; and then the salutary results, so far as the surface is concerned, depend upon special vital influences exerted by the remedy upon the skin, and reacting sympathies. This is exemplified by the profound effects of tartarized antimony and ipecacuanha, the uselessness of hot water, and the frequent pernicious results of the compound powder of ipecacuanha, when free perspiration may follow the administration of either (§ 514, *h*). The effect, therefore, upon disease depends but very little upon the evacuation from the skin, as produced by what are called sudorifics; but upon the peculiar action which may determine the evacuation, and its consequent alterative reflex nervous influences. And this, by-the-way (for these opportunities may not be neglected), shows us the futility of the chemical hypothesis of the formation of the secretions.*

692, *b*. Though sweating be generally a symptom of good omen, it may be one of the worst. Thus, a person suddenly falls down, in-

* See NOTE D p. 1114.

sensible, and copious perspiration ensues. It may be death from hemorrhage, or from a sudden cessation of the action of the heart, or it may be temporary syncope. Again, profuse perspiration often appears suddenly in protracted stages of disease. If the other symptoms are bad, the sweating is still more so. In these cases the pulse is generally small and rapid. But it sometimes denotes the near extinction of life when the pulse gives no sign of danger, and the sweating may be even considered favorable if the whole circumstances of the case be not carefully weighed.—A viscid state of the perspiration is commonly significant of great force of disease. In some fatal cases of the cholera asphyxia there was only an insensible perspiration, throughout (In my "*Cholera Asphyxia of New York*," 1832).

693. *Mucus.*—The mucous tissue being every where more or less exposed to irritating agents is naturally protected by mucus, as the skin is by the cuticle; but only in quantity sufficient to cover the surface of the membrane. When, therefore, it is continuously discharged from the nose, expectorated from the lungs, or voided by the intestine, bladder, or uterus, it denotes a morbid state of the tissue; and that state is of an inflammatory nature. This is plain enough in respect to the nose, throat, lungs, and bladder; but the analogy is neglected in relation to the intestine, where it often supplies an important indication in the absence of other prominent signs of inflammation. This morbid organic product is liable to great varieties in its appearance and properties, each one of which depends upon a special modification of inflammatory action (§ 409 *h*, 410, 415, 682 *b*). Its exact condition will also conform to the natural modifications of the vital properties of that portion of the tissue which may be the seat of disease. Hence, in part, the varieties attending the morbid conditions of mucus, as it may proceed from the eye, nose, throat, lungs, and intestine (§ 133–135, 682 *b*).

Unlike the excrementitious products urine and sweat, the product of the mucous tissue, like all other organic compounds, is uniformly the same in health in the same parts of the tissue, nor is it liable, like the former, to undergo chemical changes as soon as secreted (§ 417). Its morbid changes are determined by the same precise laws as is its natural condition, and therefore each change depends upon some precise accidental modification of the vital properties and actions, and according to their natural modification in the part from which the discharge may proceed. Could we, therefore, always ascertain the precise character of its morbid changes we should arrive as nearly as possible at the particular condition of the existing disease (§ 237, 682 *b*. Also, *Med. and Physiolog. Comm.*, vol. ii., p. 197, *note*).

694, *a. Alvine Discharges.*—The fæces consist of the superfluities of food, and the remains of various secreted products which are poured into the intestine from the liver, salivary and pancreatic glands, and mucous tissue. But, neither the bile, nor saliva, nor intestinal mucus, nor the gastric juice, appear in the fæces in their natural state. Combined, however, with the fæces, they offer a general natural standard for comparison with the morbid conditions.

694, *b*. In disease, the foregoing natural conditions as to quantity and quality of the secretions, and the state of the residual food, are more or less affected, according to the nature of the morbid states which may attend the various parts concerned in digestion. From the

number of organs, therefore, that are liable to be simultaneously involved in morbid processes, and which contribute their fluids to the alvine dejections, as well as the imperfect changes which the food undergoes in the stomach, it would seem more difficult than it is, in reality, to derive any just conclusions as to the nature of disease from the condition of the fæces.

The following are the most important signs to be noticed in the alvine discharges:

1st. *The Residual Food.*—This gives us intelligence as to the state of the stomach. It is mainly important in chronic affections of that organ, or during convalescence from acute disease; since, till the subsidence of acute diseases, the food should consist mostly of fluids, whether the stomach be the direct seat of the affection, or disturbed by reflex nervous actions, or liable to irritation from solid food in the absence of those conditions (§ 512, 514 *h*, &c.). We may be thus guided, also, as to the food which should be avoided.

2d. The *nature and quantity* of the matter discharged.—This, in acute diseases, will consist, principally, of the secreted fluids, which, so far as produced, may cease to be in any way appropriated, and accumulate in the intestine, though much, in respect to the apparent accumulation, may be due to the absence of residual food with which the secreted products are habitually intermixed. Their deficiency, during the operation of a cathartic, denotes severe disease in the organs of digestion, especially the glandular, or that an unsuitable cathartic has been applied. If the evacuation be large, watery, and colorless, the cathartic was bad. It has irritated, morbidly, the intestinal mucous tissue, has not reached the glandular function of the liver, or may have propagated injurious influences upon that organ. If a judicious cathartic have been employed, and not in excess, and mucus alone follow, it shows inflammation of the intestinal mucous tissue, and disordered action, probably congestion, of the liver (§ 693), which will be aggravated by a repetition of cathartics till the disease be lessened by other remedies; of which general bloodletting, leeching, and blistering, are the principal. Or delay of all remedies may be sufficient (§ 856, *a*). Again, a *redundancy* of bile may be either unfavorable or favorable, and its proper interpretation may depend upon a variety of considerations; such as color, the period and past history of the disease, the general and local vital signs, the nature of the remedies, especially of the cathartic, employed, &c.

When the bile is redundant, the mucus is apt to be at least natural in quantity, and when the latter is in excess the bile is commonly deficient, since, in the latter case, the formation of bile is diminished by morbific reflex nervous actions propagated upon the liver by the mucous tissue. It is the same as when morbidly-irritating cathartics diminish or stop the secretion of bile. And here I will say, that I am far from meaning alone what are denominated the drastic cathartics; since calomel, blue pill, and even the neutral salts, may be more morbific in a given state of disease than scammony, colocynth, aloes, and especially jalap, in doses of corresponding energy (§ 889 *g*).

When the secreted products increase after having sustained a diminution, the sign is, perhaps, always favorable; but how far so will depend upon other symptoms, and upon the amount which is due to nature. In some hepatic congestions cathartics procure but small

evacuations till the disease is considerably overcome. The secretions then start, become abundant, long continued, and a salutary bilious diarrhœa sometimes sets in. The same is also true of jaundice, whether arising from disease of the liver, or from obstruction by gall-stones.

3d. The appearance of the fecal matter as to *color*.—This is a very important index in many respects. We should distinguish carefully, however, what may be owing to color of food, or what may be imparted by medicine, from that which is morbid.

If the discharges be light it shows a suspended secretion of bile, which may be owing to the irritation of an improper cathartic, or to inflammation of the intestinal mucous tissue, or to inflammation or congestion of the liver, or to jaundice, &c., and the other symptoms will clear up our knowledge upon the subject. In all these cases, as disease gives way the bile is secreted in redundance, is apt, at first, to be blackish, or of a deep green, then changing to brown, or to a dark yellow, till it finally becomes of a lightish yellow.

Calomel and acids are very generally supposed to render the bile green. This they will do when mixed with the bile out of the body; but this chemical effect is counteracted by vital resistances afforded in the intestinal canal, just as putrefaction is arrested in food by the same agencies (§ 339, *b*). No quantity of calomel will impart a green color to the discharges of a healthy subject, nor will any acids; being an inquiry which I have sufficiently submitted to experiment. When, also, the bile becomes redundant and yellow during the decline of abdominal disease neither calomel nor acids will affect its hue, unless a morbid irritation be produced. At the onset of disease there may be no green appearance of the dejections till calomel or blue pill be given; but the reason is, that, till then, the secretion of bile was suspended, and what was accumulated in the gall-bladder is now dislodged. The mercurial agents excite the liver and it pours out its morbid product; or, if they aggravate the existing hepatic derangement the green may be increased by this vital influence of the agents, or the secretion of bile may be wholly arrested.

It is important to do away with these misapprehensions; since they lead us to regard what is truly an important symptom of disease as the mere result of accident. The experiments, also, *out* of the body show us how fallacious are all such pursuits (§ 1058 *b*).

The worst appearance of the bile, *per se*, whether vomited or dejected, is a bluish color. It shows severe and obstinate congestion of the liver. Bloody mucus denotes more intense inflammation of the intestinal mucous tissue than a redundancy of simple mucus (§ 693). It shows dysentery if attended with pain and tenesmus. Hemorrhage from the bowels or stomach denotes venous congestion and inflammation of the mucous tissue in most cases; though now and then in congestive fevers the hemorrhage comes from the liver. In all the cases it is an effort of nature to relieve a very formidable condition of disease (§ 805. Also, *Med. and Phys. Comm.*, vol. i., p. 371–384; vol. ii., p. 546–566).

4th. Of the *sensations* produced by the fecal discharges on passing the anus.—These are mostly of a burning or excoriating nature and denote either the presence of a morbid condition of the bile, or of acids that are generated by the decomposition of food. The suffer-

ing, however, generally arises from an acrimony of the bile. Aloes will, doubtless, produce irritation of the anus in some degree; but, when consequent on the use of that medicine, it arises mostly from the bile which aloes is particularly instrumental in eliciting from the liver; while its sympathetic irritation of that organ will also increase the morbid acridity of the bile. The fact is practically important, as will be readily seen from its bearing upon our conceptions of disease, and of the virtues of remedial agents (§ 1063 *b*).

694½. From what has been now said, it is evident that the dejections should be always examined in all diseases of any severity and obstinacy; and, if produced by a cathartic, they should be all examined, and each one in the order in which it may take place. This is the only way of practicing medicine intelligibly. The evacuations often supply more information as to the state of the abdominal viscera than all other symptoms. I say, therefore, when cathartics operate, it is often important to examine the dejections in the order in which they may take place. The first may consist only of the fæces resulting from food, and of secretions which had not assumed a morbid aspect. With this partial inquiry, as is often the case, we may conclude that all is right with the abdominal viscera, or that they are in a state to bear any violent remedies we may choose to exhibit for other purposes. But, on inspecting the second dejection, we may find it like chopped grass, or of a black, pitchy aspect. This brings us to the conclusion that mischief prevails at the fountain of life. What was evacuated at this second discharge was perhaps nearly the whole contents of the intestinal canal; and what may be evacuated at the third, or fourth, or farther dejections, will have been secreted after each successive evacuation.

If any salutary changes, then, be exerted by the continued operation of cathartics, we shall be likely to discover them in the color and other appearances of the discharges, as they come away one after another. If they remain without change more work is to be done.

694¾. It appears, therefore, that modifications of mucus, wheresoever it occurs, and of the component parts of the alvine discharges, are essentially different from the morbid phenomena attending the pulse, the tongue, and the urine, as indicative of the nature and force of disease. The first being the direct results of organs morbidly affected are critically significant of the pathological conditions (§ 741 *b*). The last three, when the organs are not the seats of absolute disease, are indirect media which denote the intensity and modifications of the nervous influence that may be reflected upon the organs by diseases of other parts. In our ordinary investigations of symptoms, therefore, which relate to the tongue, the circulatory organs, and the kidneys, we are employed, however unconsciously, in estimating the relative conditions of reflected nervous influence, and by which we judge of the nature of the pathological conditions in which these influences originate; although in respect to the tongue its morbid phenomena may be more or less owing to continuous sympathy in affections of the alimentary mucous tissue (§ 498 *f*, 500 *m*, 526 *a*, 715–719). And yet this is the great field of Humoralism.

This analysis may serve the useful purpose of drawing attention, for the first time, to the philosophy of the subject, and thus contribute toward an understanding of the same philosophy as it respects diseases which grow out of each other, and the operation of morbific and remedial agents (§ 826 *cc*, 961 *a*, 970 *c*).

PATHOLOGICAL INDICATIONS FROM MORBID ANATOMY.

695. Lesions of organization, and all deviations from natural conditions which occur during life and are obvious to the senses after death, are embraced under the denomination of morbid anatomy.

696. All the foregoing results are owing to the pathological states which essentially constitute disease, and would not, therefore, ensue, could disease be removed soon after its invasion, or in its formative stage (§ 639, &c.). It is a great object of art to prevent their occurrence, or, as it is termed in the treatment of inflammation, to effect a resolution of disease.

697. Morbid anatomy has been pursued with various opinions as to its relative value to the vital signs of disease. Those who have regarded it of paramount importance have entertained but very limited views in physiology, or of the laws of disease. They have always considered the organ which was most frequently altered in its condition as the great primary seat of disease, and the cause of all the other lesions and phenomena, and even the cause of death. This doctrine, and its fallacies, I have considered very extensively in an Essay on the writings of Louis, and in another article devoted specifically to the inquiry; both of which appear in the *Medical and Physiological Commentaries.*

698. Morbid anatomy is indebted to Bichat for its rank in science, by whom it was cultivated in its most philosophical aspects. It was this great man who first employed it, extensively, in illustrating physiological and pathological problems; but more especially did he convert the living phenomena of disease to the uses of physiology.

The fruits which were thus gathered from morbid anatomy appeared to represent the field as a *terra incognita*, where great discoveries were to be made, and, therefore, great fame to be realized. The older pathologists were either unknown, or crowded aside; while the very ground which they had gone over was brought forward as newly-discovered land. The multitude lost sight of disease in its vital aspects, and undertook a system of pathology out of the last wrecks of disease; not unfrequently confounding the results of putrefaction with those of vital actions. Such was the general state of this branch of science, upon which, also, humoralism had again reared its venerable form, along with many other physical and chemical doctrines, when I undertook their systematic examination. Nor do I say this in a spirit of arrogance, but as simply due to the philosophy which I have endeavored to defend.—*See* Rights of Authors, p. 912.

699, *a*. There has constantly been, however, a group of medical philosophers who have remained true to nature; and the profession, therefore, split into two classes, taking the names of the Hippocratic and the Necroscopic or Anatomical schools. The Hippocratists are observers of Nature in all her aspects; while the Necroscopists only contemplate her ruins.

699, *b*. The Hippocratists maintain that Nature is most significant of her existing conditions while those conditions actually exist, and

that we may better infer the nature of present causes by their immediate effects, than by the effects of other causes which may happen a week, or a month, or a year afterward.

699, *c.* The Necroscopic or Anatomical school maintain exactly the reverse of the foregoing. If, for example, a case of inflammation of the lungs occur, they allow no satisfactory conclusions as to the nature of the disease till the patient is dead, and it can be seen whether there be certain morbid changes of structure, or certain physical products, which they assume as necessary to constitute inflammation. "In this country," says the *British and Foreign Medical Review*, "few would be disposed to admit that inflammation had existed, unless some of its known products were brought forward as proofs." If, therefore, a patient die of inflammation in its formative stage, and before any of its peculiar products take place, it is contended that there was no inflammation, however violent and characteristic may have been the vital signs. Hence it is assumed that the cause of death, in cases of that nature, is wholly unknown (§ 748), or, "they are *like* inflammation, yet *totally different*" (§ 1024 *d*). The *London Lancet* has a more proximate philosophy. Thus: "Inflammation CONSISTS in this, namely, that the *fibrin*, &c., which should pass *from the arterial into the lymphatic system*, [!] passes into the *venous*. The true nature of inflammation lies in the above few words" (April 8, 1843).

A few of the most eminent of the Necroscopic school have exploded inflammation as a disease. This is extensively true of Louis, and universally so of Magendie and Andral; the last of whom affirms that "it is like an old worn-out coin, which ought to be discarded from circulation" (§ 753). Of fever, he says, "*The progress of science* has induced me not to devote, as in the former edition, a special volume to fevers."—"Singular '*progress*' that!" exclaims Cayol; "a few such steps, and medical science would be down at zero" (§ 740 *b*, 744). The distinguished Travers, in commenting upon the Anatomical school, especially its corruptions in France, remarks that, "out of the *debris* of the dead subject, however accurately inspected, examined, and arranged, to attempt a solution of the great problem of living actions, and to build upon such a foundation an edifice of pathology of self-support, is as injurious a fallacy, and scarcely less arrogant and absurd, than that of the Cartesian Philosophers, who undertook, out of the depth of their anatomical sagacity, to make a man."—NOTE F.

699, *d.* Again, in another case where there may have been a succession of inflammations in different organs, and, although one or more in the series shall have entirely subsided, but the real cause of all that followed, it is assumed by the Necroscopic school that the last in the series had been the cause of all the phenomena from the beginning of the complaint. Such, indeed, as well as the preceding doctrines (§ 699, *c*), is the natural result of that large school of materialism which pretends to discover in the structure of organs, even in their molecules, the various conditions of life, and all its diversified phenomena (§ 131).

700, *a.* Take any case, in the wide range of diseases, and ere its termination, it may present many new problems for the pathologist. It may have lost its original character, or its variations may consist of such modifications of a common pathological cause, that the cure shall require alternations of opposite remedies. Every pathological change

is ascertained through the direct phenomena, and is a far more difficult effort than the primary conditions. Morbid anatomy contributes nothing through all the intermediate changes; and what, therefore, is its positive benefit in any given case of disease at its invasion or termination if it supply us nothing throughout its progress? The whole matter is settled before morbid anatomy can yield its light; and Nature would have been untrue to herself had she left her dependence upon art to her own ruins.

700, *b*. The physical products of disease can, at best, only denote the nature of an antecedent functional action in which the essence of the disease consists, and which has more or less terminated in the particular part when the lesions of structure and morbid depositions have taken place (§ 732 *b*, 863). On the contrary, if disease consist in structural lesions, or other physical products, to what practical result does morbid anatomy conduct us, if it inculcate such a doctrine? Organic lesions, and often preternatural formations, are to the physician what they are to nature,—ulterior results; and they are equally unacceptable to both. If the positive symptoms of inflammation are to be set aside from want of some of its terminations, or even of vascularity, the foundation of practical medicine will be swept away, and clinical lectures should be confined to the dissecting-room (§ 730 732 *b*).

701. Morbid anatomy, as taught by the materialist school, has precluded all regard for those pathological conditions upon which the lesions of structure and physical products truly depend, and about which the art of medicine is mainly interested. In its indiscriminate career, indeed, it cuts off all diseases except such as are known to the vitalist under the name of inflammation, and to which he refers those lesions of organic action and those new formations which alone engage the school of materialism. But the vitalist believes that "it is a rule of no small moment, in acute diseases," as expressed by Senac, "that there may be great disorder in the functions of the body without real inflammation, or any *fixed* disease in the solid parts. Yet these parts, which have experienced such deep and distressing affections, may, in a short time, be entirely relieved." "At the termination of a paroxysm of malignant fever, the terrible symptoms abate, and oftentimes disappear."

702. Morbid anatomy has not, in an original sense, ever given us a solitary clew to the pathology of disease, any more than healthy anatomy to the natural organic functions. We revert, at last, to the vital indications, or other immediate results, for this knowledge. The local symptoms are often an unerring guide, and many which spring from reflex nervous actions, where morbid anatomy professes nothing, yield also their flood of light. We analyze the whole group of phenomena, and, by the aid of experience and principles, we go to the work of cure without a doubt or hesitation. There is no other mode of practicing medicine. Or, suppose the anatomist to attempt a therapeutical application of his own materialism, physiological and pathological; could he even *begin* to consider the condition of disease, or the nature of its treatment (§ 500 *m*, 514 *f–m*, 647½, 694½, 904 *a*, 990⅓ *a*)?

703. The legitimate objects of morbid anatomy are to expound the sensible changes which may take place in the instruments of morbid action, the lesions of structure, and other new formations, which may

supervene upon disease. These it associates with what had been determined by the phenomena during life as to the essential pathological conditions; and, when doubtful cases may arise, from the absence of symptoms, should the physical results occur which have been found to be the regular sequelæ of certain known pathological states, it is then that morbid anatomy reflects its posthumous light with various degrees of importance. Yet certain it is that morbid anatomy can be of no advantage, so long as the symptoms, the true indices of disease, may be absent in any subsequent cases of the same nature, till the patient is again subjected to the scrutiny of the scalpel.

All physical results stand as the ultimate signs that a certain mode of action had existed, since these are the consequences of that action, of which the vital signs had been the attendants, and which had formed the sole ground of that pathological induction, which, after a series of observations, the physical products illustrate, and are taken merely as an indication that these vital signs, the basis of pathological inductions, had been present.

704. It is manifest, therefore, that the materialism inculcated by morbid anatomy destroys all rational attempts at pathological inductions during the treatment of disease; since, if the true import of the vital signs depend upon the ultimate contingency supposed, no just conclusions can be formed, either as to the nature of disease, or the mode of treatment, till the patient is dead. This, it will be allowed, is repugnant to reason; from which it will follow that the premises are wrong, and that true pathology reposes upon the vital emanations of disease (§ 756, *b*).—Note F p. 1114.

705, *a*. It is, then, upon the symptoms of disease, its remote causes, and the effects of remedies, that we are to depend in reaching all practical knowledge of any individual case, and, therefore, all cases of disease. But, since the physical products of disease which are comprised under morbid anatomy are the results of the same properties and actions upon which the vital phenomena depend, they form an ultimate and subordinate source of information; and since they concur, more or less, with the primary remote causes of disease in ultimately modifying the phenomena, it is important to know, as far as may be, the extent of their influence in this respect.

705, *b*. I may say, therefore, that the greatest practical use of morbid anatomy is the knowledge it supplies of the tendency of certain pathological conditions to result in the formation of physical products, or in disorganization; thus giving that direction and energy to practice that may be necessary to counteract the supervention of these deplorable consequences of disease. A second important practical advantage is the discrimination which morbid anatomy enables us to make between those phenomena which are the result of simple morbid conditions, and such as depend upon, or are modified by, the supervention of physical products.

706. Morbid anatomy can never alter the general principles which it may have assisted in forming. When, for example, the nature of common inflammation is ascertained in one part, principles are established which are applicable to this disease in all other parts, and at all times, and under all circumstances. The varieties must be ascertained by interrogating the particular phenomena in each individual case, and the treatment adapted accordingly. The great principles

will, of course, be always under the modifying influence of the phenomena from which they have been deduced, according as the principal phenomena may fluctuate.

707. When the structure of parts becomes deranged, or the properties of life are verging toward an extinction, we have totally a new order of things. Pathological principles are then upon the decline, and therapeutics is more or less afloat, and without compass, on the broad ocean of experiment. The organic being is fundamentally changed in his structure, and the laws by which he is naturally governed are more or less broken up. And I may also add, without intending to discourage its legitimate pursuit, that here it is that morbid anatomy begins, and has reared its pathological fabric on the ruins of organization.

708. Whenever morbid anatomy has been in the ascendant, the practice of medicine has been either experimental and empyrical, or has run into a mere system of "watching," or what was anciently denominated "a meditation upon death." We need only turn to the present state of medicine in the Capital of France for a melancholy exemplification of what I now state, and which I have set forth extensively in my Essay on the Writings of Louis.

709. The foregoing section leads me to a review of the past, and to inquire how far events have justified my former conclusions as to the superiority of American practice, and of American medical education, over European, as expressed in my Essay on the *Comparative Merits of the Hippocratic and Anatomical Schools.* I had deprecated more especially the corruptions of French medical philosophy, and was led to remark, that, "already our young men are crowding the schools of the French Metropolis in pursuit of a more thorough knowledge of morbid anatomy; and immuring themselves within the walls of Parisian hospitals, to contemplate the worst ravages of disease upon subjects of broken-down constitutions, and who have passed the ordeal of French hospital practice. They return home with Gallic pathology, and the *results* of Gallic therapeutics, which they could not realize in their own country, and will never witness again but by carrying out the principles which have supplied them with their means of information."—NOTE W p. 1127.

It is true that a few have been not a little employed in disseminating these corruptions in this stable land of sound medical philosophy; but, nevertheless, I am still able to repeat, that, "What Americans have received from the devotees of Morbid Anatomy, or from such as would make Chemistry the basis of organic science, has only tended to show them more distinctly, that the phenomena of life, in their various relations, are the true foundation of principles in medicine" (§ 350–350$\frac{3}{4}$, 744, 821, 830).

And now, having obtained the requisite permission from one venerable in years, profound in science, and long eminent as an expounder and teacher of medicine, and practically familiar with European habits, I shall here subjoin an extract from a letter which he did me the honor of addressing to myself, from Louisville, Ky., April 5th, 1846.* I am immediately prompted to this step by the

* In alluding to my DEFENSE OF THE MEDICAL PROFESSION OF THE UNITED STATES, Professor Caldwell goes on to remark that,

"On perhaps every part of your unsparing career throughout your task, from begin

manner in which the Medical Profession of the United States has been lately presented to the World by the Medical Society of the State of New York, in the hope that I may be thus instrumental in

ning to end, my sentiments accompany you, and probably on *one*, at least, leave you a little in the rear. I allude to the *practical superiority* which the physicians of our own country hold, in general, over those of Europe, and I presume also, of course, of every other portion of the globe.

"Respecting the treatment of chronic complaints I forbear to speak; because my knowledge on that point is less full and thorough, and therefore my opinion less positive. But, in their rational, skillful, bold, and successful treatment of acute diseases, particularly of the classes *febres* and *phlegmasiæ*, the physicians of the United States are incomparably superior to any Europeans whose practice I have either witnessed in person, or read of in books. That this is true in relation to American complaints cannot be denied. Nor, in my opinion, is it less true in respect to those of transatlantic countries.

"Of all the physicians in Europe of whom I have any knowledge to be relied upon, I am most partial to the practice of certain Dublin gentlemen, and of those in some parts of Italy. In their treatment of disease they have often reminded me of *home*. And of all the practice I have ever witnessed, that of Paris is the most inefficient and miserable. Yet is it this Parisian school in which American pupils are most anxious and proud to be educated, and to which they are advised to repair; and most unwisely and inconsiderately advised. As far as *the practice of medicine* is concerned, if they do not there learn how *to kill* the sick themselves, they learn, or may learn, to perfection, the art of allowing their complaints to kill them. Never have I witnessed in Paris a single well-directed Herculean blow attempted in a case of fever. The battle was always fought in a Lilliputian manner. Nor, were I to say the same in relation to English and Scotch practice, would it be easy to refute the assertion. It is a well-known truth, that European physicians of every nation, who migrate to America, are, on their first removal, incompetent to the successful treatment of the complaints of the country; nor can any thing but experience render them competent to it.

"It is undeniable, that the physicians of Europe are, *in the mass*, very far from being an able and elevated body of men. Strike off the few, I might say the comparatively very few, who alone give lustre and standing to the profession, and the remaining 'million' will be found to be positively and strikingly the *reverse*; a very ordinary body, possessing not an element of distinction on the ground of either *talent* or *attainments*. And the same is true in relation to the pupils whom I have seen in attendance on the European schools. A majority of them, which may be called *vast*, are, in appearance, far inferior to the pupils of our own schools. Nor have I the least reason to believe them much if any less, inferior in *mind* than they are in *person*. In proof of this, the American pupils, whom I have seen in attendance on foreign schools of medicine, were, in no ordinary degree, the finest young men belonging to the classes; the foremost, I mean, in every essential attribute of standing. Of this they were themselves confident and proud; and so was I.

"It is not true, then, that the *mass* of physicians in Europe are, in any respect, superior to the mass in the United States. In their treatment of disease, I fearlessly repeat that they are *decidedly inferior*. On each side of the Atlantic, the *west* not less than the *east*, there exist in the Faculty the *eminent few*, who, in talents and knowledge, are nearly on a par; the Americans, however, being at once the most efficient, most rational, and most successful practitioners.

"While I yield to no one, therefore, in the estimate I place on the *leading physicians* of Europe, I cannot admit that those of the United States are in any respect their inferiors. And I should deem myself unworthy my *birth-right*, were I not to discountenance the wordy tirade poured out so superabundantly in certain quarters, in disparagement of the education and standing of the great body of American physicians.

"For the inferiority of the mass of European physicians a plain and substantial reason may be assigned: they are enslaved by precedent and trammeled in mind, and are not, therefore, independent thinkers. And I need hardly add, where independence of thought is wanting, so are vigor and efficacy of thought."

"An overwhelming majority of the physicians of Europe reside and practice in country places, villages, and small towns. And, as already alleged, they are, *ab origine*, more or less of an inferior *caste*. Their education is also inferior. Hence, conscious of their inferiority, they look upward for light and direction, and *follow* those whom they acknowledge as their superiors. In this they but conform to the European *fashion*, according to which the lower orders of society do a sort of homage to the higher, and walk in their footsteps. So true is all this that there are few, if any, *medical commoners* in the Old World, who venture to think in any other way than *by authority* of some writer or teacher; whom they obey and adhere to as retainers do to their feudal lords. I need hardly subjoin, that in a condition so humiliating, it is impossible for physicians to rise to eminence.

"Much of this, however, you have yourself stated in your '*Defense of the Profession*,' or elsewhere. But I am not apprized of your having stated that the American youth can be *much better educated* in their own country than in any foreign one. Yet is the fact unquestionably true. I mean that it is a *fact*, and not a narrow-minded, selfish assertion. The real proximate elements of medicine are more thoroughly taught in some American

obliterating unmerited reproach, and in inspiring my medical countrymen with that consciousness of worth, and self-respect, and self-dependence, which they are so eminently entitled to enjoy.

schools, than in any European ones I have ever visited. This is especially true in relation to the *Principles or Philosophy* of medicine; without an acquaintance with which the practice of the profession is rank quackery."

I have no disposition to pursue the foregoing subject beyond what may seem expedient for the defensive purposes which common justice urges upon an injured right. The scope of remark is therefore designed to extend far beyond those domestic relations which might be adjusted without foreign aid. But our own self-reproach was not the offspring of conscious degradation. It was but the sequel of disdain which prospective greatness never fails to encounter on its triumphant march. The aspersions of the mother-country had been received in the dignity of silence, and they who undertook the game at home calculated to win through an imaginary acquiescence in foreign diplomacy and an accustomed non-resistance. All that was noble in our land had been the subject of unmitigated scorn; and so it progressed under the blandishments of diplomatic skill. I will not point, in testimony of this, to the "London Quarterly," or political, or other journals of inferior note; but that which has reigned supreme in the world of letters unfolds an amount of proof at which Honor and Humanity hang their heads in shame. The blows have not fallen upon the imbecile and weak. That is the coward's work, and would have yielded nothing to the final cause. A nation has been the intended victim, and therefore a nation's pride has been the target. The critique upon Channing in that National work, the *Edinburgh Review*, for April, 1839, is alone enough to dishonor any country, at any age.

I shall, therefore, briefly sustain the foregoing comparative estimate of the Medical Profession, in a limited application to "the Mother-Country." I complain not of any other; and revere the ancestor as a fading luminary, of the largest magnitude, whose resplendent light has only passed into other regions to advance the welfare of other worlds. I shall sustain the comparison, I say, by a quotation of one of many analogous comments that have lately appeared in a medical work which may be regarded as the oracle of the British Profession,—the LONDON LANCET.—NOTE W p. 1127.

In speaking of the existing state of medicine in Great Britain, and after representing British "works on pathology and the practice of medicine as deficient in originality and richness of materials," the veteran editor aims his Lancet at the very foundation. "Look," he says, "at the state of British pathology! Of what does the great majority of our books on this subject consist? Of compilations; of old views cooked up as new discoveries; of annotated translations; or, at best, of able and comprehensive digests of materials that were already before the public in other forms."—*London Lancet*, May 6, 1843. And may I not adduce, in support of the *Lancet*, what I have said in former sections of the reference and surrender of British medicine to the laboratory of a German chemist (§ 349, *d*, 376½, 676, 878)?[1]

Shall Americans, therefore, go on to decry the efforts of their own medical scholars, degrade the whole profession of their own country, and sacrifice their own medical literature for what is conceded to be the present medical literature of Great Britain? It is not mine to complain of British critics for promulgating what could not be concealed; and, doubtless, it is the only remedy for professional apathy, the only stimulus to "medical reform," the only motive for "Parliamentary action," and the only means of extending education and of rescuing the practice of medicine from the hands of "*apothecaries*."

There has been no occasion for vindictive motive; which never fails to tarnish truth or polish error. The common ends of life are known to all, and each in his place, in the scale of conscience, weighs, to the weight of a thought, the right and the wrong. What was once true is true forever; and nothing has stood the test of truth like the great elements of national decline. In vain do we point to our former greatness, and call for help upon the past. The very power of example is gone. What was noble, was virtuous, was intellectual has passed to other regions, is cherished and honored in other climes. It is lost only to the land of its birth.

While, therefore, we adopt whatever is valuable from abroad, let us have a literature of our own, based upon American observation, American industry, and American genius. But, as I formerly said, let us remember the admonitions of history, that, when nations have begun to trample upon the past, to reject its experience, and to strike out new systems of observing Nature, it has been the most certain presage of approaching imbecility, and of that ultimate fall to which all are destined. When the great revolution shall have reached the Genius of Philosophy—"*το κρατιστον της φιλοσοφιας*"—the last vial of wrath is emptied, and that nation is irretrievably gone. This is humiliating to pride, and may have been designed as one of its correctives. But since *it is so* in the great plan of Providence, it must be sufficiently obvious, that, as a nation approaches its chaotic state, those who may be in the ascendant are bound neither to counteract the order of nature, nor to suffer their own prosperity to be blighted by the mildew. Ambition must follow the beaten path of philosophy. The denunciation of past experience is the ambition of egotism, which erects its innovations upon error, and imbues them with superstition and absurdities.

I say, therefore, let us have, at least, a *medical* literature of our own. There is nothing that will contribute like it to the nationality of Americans, nothing that will inspire so extensively the culture of other sciences, promote the advancement and refinement of the

[1] *The* LONDON LANCET *will concede that all things remain in statu quo*, 1860.—*Vide Note*, p. 517.

Other, and perhaps I should say more important objects, are contemplated by this note, and which form no small part of the interests of medicine. They are the same which I have had uninterruptedly in view. They are those which are intended to designate the consequences of spurious systems. Those systems and their results must be displayed; and that, too, in connection with what may be designed as substitutes. Nor is there any inquiry in which this method is so indispensable as in the philosophy of medicine. Truth would never obtain, till the "lion shall lay down with the lamb," unless the Institutes of Organic Nature are presented in forcible contrast with the devices of art. It has been tried from the day when Hippocrates evolved the philosophy of medicine from Nature herself, and dragged it from the midst of error and superstition. It has been tried, I say, in vain. The present times bear me witness of the fact. The mind must enjoy ready means of comparison. Nay, more, the comparisons must be planned, matured, logical, and irresistible. Such, only, can give stability to medicine; can, only, illustrate and enforce the truth. I have made the attempt: I do but say a humble attempt. I design it as an example for more able pens; and ever consistent and firm in the views which I have now expressed, I would cheerfully become, upon my own method, the victim of a better philosophy. I would have corruptions, speculations of all kind, swept with an unsparing hand from the tablet of organic nature; and while, therefore, whatever I may have attempted shall remain unrefuted, uninvalidated, or however it may receive approval, or be condemned without "the ordinary prerogative of being presumed to be true until the contrary is clearly shown" (§ 376$\frac{3}{4}$, *a*), I shall suffer the method of inquiry to remain undisturbed, the exposures of error to hold firm their places, in any future editions of this work; that they may unceasingly contribute to their original objects, and admonish the pretender, that some one more competent to the task may fasten upon him a universal verdict of guilt. They will therefore remain, as a safeguard to medicine, till the corruptions be shown to bear on their front the broad seal of Nature.*

useful and ornamental arts, nothing that will so effectually confirm and carry forward that elevated rank which the Medical Profession of the United States have already won for themselves in the hearts of their countrymen. We have, indeed, already the foundation of such a literature in the multifarious writings of the hard-thinking men of America; and it is this very literature, and the general dissemination of knowledge in the American Medical Profession, their indomitable industry, their well-directed skill, and their discreet and dignified bearing, which give them higher rank, greater influence in society, than any other class. Look where we may, we shall be likely to find the medical man foremost in enterprise, turning night into day, leading in measures for the public health and for its general prosperity, curbing the impetuosity of error and superstition, rearing and consecrating temples to the Divinities of Health wherever a dozen worshipers can be found, and stretching out an influence which awakens all the elements of learning and industry. It is the Profession alone which is not true to itself.

In all that I have now said, I may not be suspected of undue partialities, for I am under no obligation to any portion of my profession in America, or of the American Republic; while I am actuated by the deepest sense of gratitude to some foreign countries that can be inspired in a man of literary habits. To those countries I am the more indebted as they are always just to my native land, do honor to her scholars, and are the great abodes of learning and philosophy. Nevertheless, in all the instances I have endeavored to speak according to my convictions of the truth, and the demands of my subjects; ever sacrificing self to those primary objects. If there may seem to have been asperity, I trust it will be found in the facts themselves, and in the unavoidable nature of the conclusions at which I have arrived.

* The subject of MEDICAL EDUCATION, and the great superiority of the system pursued in the United States over that of Great Britain, was resumed in a series of seventeen numbers, which I contributed (but which appeared editorially) to the *New York Medical Press* (from Jan. 29th to June 4th, 1859), founded upon Parliamentary doc'ts.

INFLAMMATION AND FEVER.

710, *a.* I PROCEED to illustrate the most important principles in medicine by considering those which are especially relative to *inflammation* and *fever;* the two orders of disease, indeed, which make up the great amount of human maladies, and form the great outlets of life. The few diseases which do not fall under one or the other of the foregoing denominations are least important in a practical sense, and least understood in their pathology. Nevertheless, a knowledge of the principles which apply to the pathology of inflammation and fever will greatly aid our interpretation of the essential changes which constitute the pathological conditions of other affections.

710, *b.* Inflammation and fever have been generally regarded as one disease, and they who have considered them distinct affections have offered no analysis by which their individuality may be established, and by which each complaint may be readily distinguished in practice. Important evils to the sick are therefore in constant progress from this source alone; and when there is added to it the entire darkness in which venous congestion has been shrouded, both in its absolute pathology and as it modifies fever and the recognized forms of inflammation, it may be safely said that a vast opening is here presented for the improvement of medical philosophy, and for the common welfare of man (§ 787, RIGHTS OF AUTHORS, p. 919, nos. 27, 28).

INFLAMMATION.

711. I shall first state the outlines of inflammation, and its essential pathological characters; from which it will be seen that it takes its rise in purely physiological conditions, and holds its progress and decline under the same great natural laws of the constitution (§ 137, 149–152, 638).

712. Unlike idiopathic fever, which is a universal disease of the body, inflammation is always local (§ 143, 148). Fever, however, is often complicated with inflammation of one or more organs at or near its commencement, and the local disease may precede the constitutional one, and even become the *exciting*, though not the *predisposing*, cause of it (§ 645, 650, 651, 653). More frequently, however, inflammations spring up during the progress of idiopathic fever, and often attack and disorganize many important parts in rapid succession. Indeed, it is rare that fever exists long without this greater foe making its appearance, and adding seriously to the difficulties and dangers of the case (§ 779).

713. Owing to the foregoing complications the capital mistake is often made of regarding the local affection as the essential or predisposing cause of the constitutional fever. Such pathologists assume, of course, that there is no distinction between fever and inflammation, and that both, therefore, are equally and always local diseases. But this is not the doctrine of those who depend less on morbid anatomy, and study Nature in her living aspects (§ 699). The single symptom which has given to fever its *name* has been a main cause of the confusion which prevails upon this subject (§ 657 *b*, 764, &c.).

714. Inflammations of much activity generally disturb, but very variously, the functions of many distant organs; but the results from their reflected nervous actions have mostly a different pathological condition from the primary disease, and such as are truly inflammatory are limited to a few parts; while all parts are affected in fever, and with pathological conditions more or less alike.

In chronic inflammations sympathies are more slowly and less extensively produced, or not at all where more acute forms would occasion great constitutional disturbance; even when the brain or other important organs may be the seat of the chronic variety (§ 140).

Acute inflammation, on the other hand, is prone to give rise, at its early stage, to what is called *febrile action*, or *fever* (§ 134, 139, 140, 150). But this kind of "fever" is purely *sympathetic*, never precedes the local affection, and is mostly remarkable for a simple excitement of the heart and arteries; while in idiopathic fever, the most violent excitement often takes place without any appreciable antecedent local complaint, but simultaneously with the general excitement all the organs appear to have become involved in a morbid process; and now, also, inflammation may as suddenly supervene (§ 143 *b*, 148). The febrile condition proves an exciting cause of the other mode of disease in some part predisposed to the inflammatory process (§ 475½–488½, 500 *m*, 514 *f*, 674 *d*, 903, 904 *a*, 990½).

It appears, therefore, that great confusion has prevailed upon this all-important subject, and that causes have been mistaken for effects, and effects for causes. The excitement of the heart and arteries attendant on inflammation appears to have engrossed attention, inquiry to have stopped short as to all other organs, and a comparison to have been alone made between the general arterial excitement of inflammation and that which is attendant on fever. In one affection the general excitement may be almost the only element of disease beyond the local cause; in the other it is only one of a great number of elements distributed throughout the body (§ 487 *h*, 500 *m*, 686, 694¾).

Again, it is fundamental with inflammation that the sympathetic development of general arterial excitement will subside as soon as the local inflammation, or primary cause, is removed; but, in fever the whole disease continues after the original cause is removed. The organs of circulation may be long subject to very high degrees of excitement, as often witnessed in the intermittent fever, without a shade of inflammation presenting itself during the progress of the disease. And how clear the characteristic distinction, that in intermittent fever the excitement disappears not only periodically, but according, also, to the type of the fever, while in inflammation it remains till the local cause is removed; when, also, the whole disease is at an end. But violent inflammations which coexist with intermittent fever may be entirely subdued, and yet the fever proceed uninterruptedly. Again, it is a common circumstance that all idiopathic fevers are introduced by a chill; while such is rarely the case with inflammations. The chill, too, and of great severity, may attend every paroxysm of a long-continued intermittent. *Other distinctions in* § 720, 757, 759, 764 *a*, *e*, 770.

715. When inflammation gives rise to general arterial excitement it is in part by continuous, and in part by remote sympathy (§ 498–500). The latter is mostly concerned in developing the general results. The nervous power being excited in the brain and spinal cord is re-

flected upon the heart and capillary blood-vessels of the whole system. That power, thus reflected, proves a stimulant to these organs, by which their action is increased, and otherwise modified (§ 188, 205 226, 480–485). Again, the same primary inflammation which thus calls up a general excitement of the circulatory system, may be simultaneously producing inflammation of some other and distant part, through the same process of reflex nervous action. That second part may have been predisposed to inflammation by some external remote cause, and the nervous power determined upon it may then operate only as an exciting cause. If the part be not antecedently predisposed, then the nervous power may prove the predisposing as well as exciting cause, or there may be other predisposing causes co-operating with it (§ 143–150, 226, 484 *b*, no. 6, 645, 652). This second part, thus sympathetically influenced, then becomes the source of other reflex nervous actions; co-operating, in this way, with the primary inflammation, and increasing more and more the action of the heart and arteries at large, and developing inflammation in other parts, while, also, the general arterial excitement is a supplementary mechanical cause. The circles of sympathy now become very complex, and interwoven with each other (§ 148); and yet, through the same laws of reflex nervous action a blow may be simultaneously struck at the whole by one decisive impression from a single remedy. Bloodletting, for instance, will do it; but the operation of this remedy, although involving the agency of the nervous power, is different, in some respects, from that of any other agent. But, suppose it may be done by an active cathartic, combined with a nauseating dose of tartarized antimony. The pathological states of the various inflamed organs are every where nearly or considerably alike. A single remedy may, therefore, overthrow at once the whole complex condition of disease (§ 137 *d*, 143 *c*, *d*, 476½ *h*, 479, 481 *g*, 484 *b*, no. 5, 514, 557 *a*, 929–934, 944 *b*, 970 *c*).—NOTE D p. 1114.

715½. So also the foregoing modus operandi of the nervous influence in inflammation is applicable to the predisposing influences of the remote causes of fever (§ 148), of hydrophobia, of the constitutional effects of mercury, antimony, &c., and of all agents, indeed, which transmit their influences to parts remote from the direct seat of their operation (§ 500, 535, &c., 657). It is all by reflex nervous action.

716. The general sympathetic excitement is supposed to often constitute a state of *general inflammation*. But this is an error; since inflammation is always confined to some limited part, the minute vessels of which, and not the larger arteries and heart, are the instruments of the disease (§ 407 *b*, 410, 411). The term *inflammatory fever* is also objectionable, as being significant of what has no existence. The term *constitutional derangement* is commonly employed to denote the sympathetic disturbances which inflammation may inflict upon parts remote from its own location. It is the same condition that goes under the denomination of *fever* when owing to the reflex nervous actions of inflammation. But, unlike idiopathic fever, *per se*, it embraces a variety of morbid conditions in different parts (694¾).

717. Inflammation occurring in one part may induce the same disease in another, and this last in a third, &c., independently of the foregoing affection of the heart and arteries. It often happens, also, that some sympathetic derangement will disturb the system far more ex

tensively than the primary affection. The heart may be the only organ that may be disposed to sympathize with an inflammation of the skin; but, when the action of the former important organ becomes disturbed, though only its irritability be increased along with that of the general arterial system, it may develop sympathetically, and by a mechanical impulse of blood, extensive derangements, perhaps inflammations, in other parts. And so, in the same vital sense, of the stomach, brain, &c., when one of those organs may sympathize with some distant inflammation (§ 139, 140, 525 *c*), by reflex nervous action.

718. The more active and extensive the inflammation, the more important the part affected, and the more irritable and disposed to sympathy the individual, the more readily, in a general sense, will constitutional effects ensue, and *vice versa* (§ 139, 140, 597 *d*, 600 *b*). Exceptions are seen in the pleura and the mucous tissue of the fauces. But only, in the latter case, under special circumstances; probably of primary abdominal disease, when the secondary affection, which is commonly erysipelatous, reacts, in its turn, sympathetically (§ 689, *l*). The special sympathies of tissues and compound organs have been already considered in a general sense (§ 525–529). As it respects inflammation, a predominance is seen among certain organs, as the skin and mucous tissue of the alimentary canal. But the principle is more readily comprehended by observing its operation among parts whose natural physiological connections are strongly pronounced, as in the principal organs subservient to the process of digestion (§ 129, *i*). The sympathetic results may not be inflammatory, or of the same nature as the primary disease; but the organs which thus cooperate in a special function are readily disturbed when any one part of the system is invaded by disease, and readily excite reflex nervous actions among each other, and throughout the body (§ 514 *h*, &c.). The general constitutional affection is, therefore, often more or less dependent on the habitual association of the action of different organs while in health, as well as upon the nature of their vital constitution and their special relations to other parts of the body (§ 129). Owing, also, to the special modifications of the vital states of associated organs, some of them sympathize more readily than others with each other, and extend their influences more readily and powerfully abroad (§ 133, &c.). Thus, the small intestine occasions sympathies more readily and forcibly than the large, and the stomach more readily than the liver, with each other. But these morbid sympathies are not mutual among the parts where they occur most readily, and the same is true of their natural sympathies. Thus, inflammation, or any affection, of the small intestine commonly produces more or less derangement of the stomach; but the same affection happening to the stomach will not equally disturb the small intestine. Gastric disease readily deranges the liver; but hepatic affections do not as readily affect the stomach. Such are plain cases of reflex nervous action.

It may be also well to remark, that were it not that one part naturally sympathizes with others, it would never sympathize with them under circumstances of disease; no more than in plants (§ 113–117, 129, 183–185, 224, 226, 349, 456–461½, 475½, 493 *cc*, 578 *d*).

719. Violent sympathetic disturbances which are especially relative to the nervous system often spring up from simple irritation of the nerves of a comparatively unimportant part, as convulsions from

teething, &c. These conditions have been confounded with absolute inflammation of the nerves (§ 526 *d*).

720. We may, perhaps, reckon as the first among my radical distinctions between inflammation and fever the fact that the constitutional disturbances of the former grow out of direct or reflex nervous influences instituted and kept up by local disease, while in pure fever they are independent of local diseases, though equally brought about by alterative reflex nervous influences (§ $233\frac{4}{5}$, $475\frac{1}{2}$, $647\frac{1}{2}$, $715\frac{1}{2}$).

721, *a*. Inflammation is a very comprehensive genus; or, perhaps, it should be rather said, it is a species of disease which embraces a multitude of varieties, forming a truly protean malady.

721, *b*. According to the varieties, it is divided into *common* and *specific*, whose details distinguish it very broadly from fever.

In its most simple form, as arising from mechanical injuries, or as manifested in pneumonia, pleurisy, catarrh, &c., it is distinguished as *common* inflammation (§ 652, *c*).

When the disease presents certain peculiarities that are not attendant on the common form, it is called *specific;* as in small-pox, scrofula, lues, gout, rheumatism, &c., and in all cases of animal and vegetable poisons (§ 650).

722, *a*. Between the foregoing characteristic examples of common and specific inflammation there is a vast range of gradations, which meet, as it were, together; so that it is evident no definite line exists, and that all the individuals belong to a common family. The very extremes are so much alike that they may be compared to twins, which we may mistake, one for the other, at a superficial glance, or may only know them apart by some peculiarities of mind or manner; but which peculiarities, again, have so many points of resemblance that the same general system of moral and physical discipline is adapted to each of the twins, with only some special modifications to suit the peculiarities of each.

722, *b*. In a general sense, when inflammation is produced by a single cause it appears under the same modification or variety (§ 652). But when two or more predisposing causes concur in establishing the morbid change the modification thus induced will be determined more or less according to their combined virtues (§ 652). Thus, cold applied to the surface generally produces what is called common inflammation. But it will also act as a predisposing cause of acute rheumatism, which is a specific form of inflammation, and therefore possesses peculiarities which distinguish it from all other forms. Hence, in this affection other predisposing causes are concerned, the principal of which may be ingrafted upon the constitution, or if transitory, may have begun the foundation of disease in the organs of digestion (§ 659, 661).

722, *c*. Inflammation is also modified by the natural peculiarities of the vital properties in the different tissues, and the sympathetic influences it may exert will often depend, both as to kind and intensity, upon the nature of the tissue inflamed, and the general nature of the compound organ of which the tissue may form a component part. As to the modifications of the disease and the reflex nervous actions as affected by the nature of the tissue, good examples of difference occur in the comparative phenomena and sympathetic effects of pleurisy and phlebitis (§ 150, 160–162, 807, 809, &c.).

As to the modifications of common or specific inflammation which grow out of the combined peculiarities of the vital properties of particular tissues and of the compound organ of which the inflamed tissue is a component part, we have numerous and striking examples; as in inflammations of the brain, stomach, liver, intestines, &c.

Again, the phenomena will be varied as inflammation may affect different parts of one and the same continuous tissue, according to the nature of the compound organs into which the different parts may enter. Examples of this occur in the pulmonary and intestinal mucous tissue wherever it contributes to variations of the general structure (§ 135–140).

722, *d*. From all that has been now said, it is evident that those lesions which have been rejected from the general denomination of inflammation by Louis, Andral, Marshall Hall, &c., and arranged under the designations of hyperæmia, hypertrophy, lesions of nutrition, irritation from loss of blood, contra-inflammatory action, &c., but attended by many of the characteristic marks of inflammation, fall naturally within the range of this variable affection, (§ 725. Also, *Med. and Phys. Comm.*, vol. ii., p. 317–331, 712–715, 760, &c.).

723, *a*. Inflammation is also divided into *acute* or *active* and *chronic*; the former being more violent than the latter, comparatively of short duration, and commonly distinguished by a greater variety of local results, and far greater constitutional derangements.

723, *b*. The foregoing pathological states, being essentially alike, run into each other; so much so, indeed, that what has been chronic may suddenly become acute, and pass with great rapidity through the different stages. There is, therefore, no other foundation for this division than such as is here indicated.

724. I am now conducted to an analysis of this disease, and shall consider it,

1. In its most simple condition, as affecting different tissues.
2. As affecting different parts of different structures.
3. The varieties of inflammation in respect to its general attributes.
4. The sympathies to which it may give rise.
5. The remote and pathological causes of inflammation.

The first four problems will be considered connectedly.

725, *a*. In a general sense, inflammation is attended by *redness*, *tumor*, *heat*, and *pain*. They were once supposed to be essential phenomena; but either may be absent, particularly exalted heat and pain. Their presence or absence, intensity or mildness, may depend upon the nature of the morbific cause, the nature of the tissue, &c. (§ 651, 722). Thus, there is no redness from the bite of a musketoe, and there is intense itching instead of the exquisite pain occasioned by the sting of a bee. None will deny that the affection resulting from the latter cause is exquisitely inflammatory, and all must allow the near coincidence between the two affections. By this analogy we bring, also, the white nettle rash, the white gangrene, scirrous tumors, &c., under one general pathological condition (§ 722, *d*).

725, *b*. Again, for example, in respect to pain, much will depend upon the nature of the tissue affected, and upon the force and kind of inflammation. Inflammation of the serous membranes is attended with far greater pain than the mucous; in which last it is often absent. Simple pneumonia may exist to an alarming extent with little

or no pain. The serous tissue, also, possesses only colorless blood-vessels in its healthy state, but is apt to become more florid in its inflammations than the mucous. On the other hand, parts which have only a dormant state of sensibility, as the tendons, bones, ligaments, may become exquisitely painful when inflamed, and more so when inflammation is produced in the fibrous tissues by a lacerated than an incised wound. There are also peculiarities as to the skin (§ 652, *c*). It is also worth observing, as contributing to a knowledge of the properties and laws of life, that while *common* sensibility is liable to be exalted in inflammations, *specific* sensibility, as seeing tasting, feeling, is apt to be diminished, or impaired in a different way from common sensibility (§ 133–137, 193–204).

725, *c*. It would appear, therefore, that increase of sensibility is only a contingent result of inflammation. This property, too, is not directly concerned in the organic functions; and a part is quite liable to become inflamed when all its principal nervous connections with the brain and spinal cord are separated (§ 188, 193, 205, 489, 500 *d*, 746 *c*).

726. There is generally more or less pulsation in the inflamed part, and in the larger arteries leading to it (§ 498, 516 *d*, 803). In all such cases the extreme capillary arteries, which are the immediate instruments of the disease, and which naturally carry little red blood, have become enlarged, and admit the red globules. This transmission, however, of the red globules is less due to the enlargement than to a change in the relation of the vital properties of the vessels to these globules (§ 192, 384, 394, 396, 398, 399).

728. Like the arteries, the veins of an inflamed part are increased in size; at least when the former are enlarged. This is owing to active dilatation of the veins, and to the increased volume of blood transmitted to them (§ 387, 786, &c.).

729, *a*. Common inflammation, when it goes on to a natural termination, and in its greatest latitude of simple results, may be distinguished into four stages; namely, the *formative*, *suppurative*, *ulcerative*, and *restorative* or *granulating*. There may be present, therefore, from what has already been said, only the formative stage (§ 700, &c.). When the disease does not advance beyond that stage, it is said to terminate by *resolution*. The suppurative and restorative stages form the most simple natural process of cure. They are also subject to great irregularities.

Pathologists have generally reckoned the *adhesive* process as a distinct stage of inflammation. It will be seen, however, that it is not founded on principle.

729, *b*. The curative stages of inflammation, whether regular or irregular, are also called *terminations* of inflammation. The term is significant of what has not truly happened; and, as words have often more force than facts, it should be abolished. There is great practical philosophy concerned about the mutations of disease at the several regular stages of inflammation, and in all the modifications to which those stages are liable. There is but one termination of disease, excepting death. Disease remains, however altered from the formative stage of inflammation, till nature is completely restored (§ 672, 733 *c*).

730. The *formative* stage is distinguished more or less by the characteristics already described.

The *suppurative* stage is introduced by a decline of all the symptoms of the formative stage, and when most regular there is a production of purulent matter, which constantly tends to a more complete removal of the formative stage.

The *ulcerative* stage is more or less attendant on the suppurative; generally attends the formation of pus excepting on exposed surfaces, when it may be present or absent (§ 733, *b*). Whenever present it is immediately antecedent to the restorative or granulating stage, although a destructive process.

The *restorative* or *granulating* stage is promoted by the suppurative, and is marked by a continued decline and ultimate disappearance of all the symptoms.

731. The foregoing stages are generally more distinctly marked in the cellular than in other tissues. With the exception of the ulcerative, they may be often well observed upon the mucous tissue of the eye. The ulcerative is seen in the intestinal mucous membrane.

732, *a*. Deviations occur in the suppurative stage in the production of coagulable lymph, or of serum, or redundant mucus, or effusions of blood, instead of purulent matter. But these results, or however they may deviate from their proper standard, are all analogous to the formation of pus, being exactly equivalent in principle, constitute equally the second stage, and, in the same way, contribute to the restorative stage, or that of perfect cure (§ 732 *f*, 740 *b*, 764 *e*, 863 *a*).

732, *b*. The fluids effused operate as depleting means; and it is especially for this reason that morbid anatomists, not finding the vascularity they had anticipated, declare that its absence in many dropsical affections denotes an exactly opposite pathology from that where the *same* affections are attended by a preternatural fullness of the vessels (§ 699 *c*, 700 *b*). Nature, however, has no such inconsistencies (*Med. and Phys. Comm.*, vol. i., p. 180–182; vol. ii., p. 187, 199, 556, 557, *note*). At the first reference here made I have quoted the *mechanical rationale* as propounded by Andral, and have endeavored to prove, by his own showing, that what are denominated "passive dropsies" depend on a vital, inflammatory action (§ 740 *b*, 805, 863 *a*).

732, *c*. When the second stage of inflammation is attended by an effusion of coagulable lymph it is called the *adhesive*, instead of the suppurative stage. This variety appears mostly in the serous and cellular tissues, though it is often presented by particular parts of the mucous system, as that of the trachea in croup, and of the intestines (§ 133–135).

732, *d*. When wounds heal from the effusion of coagulable lymph, it is by the "first intention;" though the process is the same as when the pleuræ unite, or the lungs become hepatized in pneumonia. In either case the new formations are a part of the natural process of cure (§ 732 *a*, *b*, 863 *a*). However momentous the evil in pneumonia, or other disorganizations, it is still the result of the great recuperative law; just as effusions of blood within the head in cases of cerebral congestion are on a par with hæmoptysis, hæmatamesis, &c., or all dropsical effusions with each other, and with the preceding results. Nature makes no digression from great principles for minor purposes. But, in the apparent contradictions now stated Nature has duly provided for the removal of extraneous matter from shut cavities, and from the recesses of organization by the function of ab-

sorption (*Med. and Phys. Comm.*, vol. i., p. 371–384; vol. ii., p. 546-566, 733).

732, *e*. It is also a peculiarity of lymph not appertaining to pus that it is readily susceptible of organization, whereby Nature accomplishes other purposes; though such organization occurring in pneumonia is, as in § 732, *d*, an apparent though not a real departure from the great law of recuperation. Being a law of Nature for reparation in other parts, it must, under equal circumstances, prevail in all parts.

732, *f*. It appears, therefore, that the *adhesive* process consists of two stages; that by which lymph is effused, and the strictly adhesive. And, although the effusion of lymph be equivalent to the suppurative process, there is superadded to the former a distinct final cause, since Nature contemplates in this modification not only the curative effect, but, also, the reparation of injured parts (§ 732, *a*).

733, *a*. When suppuration occurs upon surfaces, as on the mucous tissue, the process happens in its most simple form. But, in other instances, as when pus is generated by the cellular or serous tissue, the matter cannot escape as when it is produced by the mucous tissue. In these cases, therefore, an obstacle intervenes between Nature and the cure, as when the formation of lymph or of serum takes the place of purulent matter (§ 732, *d*). But here, as there, Nature has provided for the removal of the secondary evil, through a principle common to all the cases, and which appertains to the absorbent vessels. This happens after the following manner, which must be briefly stated as characterizing an important law, and the third stage of inflammation.

733, *b*. The process is called *ulceration* (§ 730). It consists in the absorption of all the tissues intervening between the accumulated matter and some external surface. It is so significant of a great final cause, so replete with evidences of Design, especially in connection with the other attendant processes, that some authors, even Hunter, have metaphorically ascribed it to something like intelligence. It is to be observed, also, that in this complex condition there is in simultaneous progress both the formation of pus and of lymph. The pus occupies the central parts of the abscess, while the lymph is effused at the circumference, agglutinates the cellular tissue, and thus, by forming a sac, prevents the spread of the purulent matter. It is yet another part of the complex law under consideration, that while the substance between the abscess and external surface is constantly yielding to the ulcerative process, *reparation* or the *granulating* process is going on posteriorly to the abscess, and the redundant lymph undergoing absorption, or what is equivalent to the ulcerative process in the anterior part of the abscess. There is, however, a certain difference between the processes; but it is less than between the absorption of lymph in the present example and the function which is in universal operation in health. In the case before us, like ulceration, the absorption of lymph is an emanation from inflammation, though more remote than ulceration. Both, therefore, may be regarded, though not equally, as pathological conditions of absorption (§ 672).

733, *c*. When the surface is reached, and the matter discharged, the cavity is no longer circumscribed. Nature now puts an end to the destructive process, and completes the work of reparation which had been in progress in the posterior part of the abscess. This is ac-

complished by the formation of a substance analogous to that which had been removed. Coagulable lymph, along with more or less purulent matter, is secreted by the surface of the ulcer, upon which it is arranged in little fleshy heaps, or knobs, of a florid color, and forms the granulations. These knobs contract and spring from the top of each other till the cavity is filled.

Among the various and striking results which are involved in this process of reparation none is more remarkable, or more strongly exemplifies its dependence on laws that are unknown in the inorganic world, than one which is least appreciated, the substitution for the granulations of an organized substance similar to that which had been removed. The granulations have, originally, the same apparent physical characteristics, from whatever part of the body they may spring. But they are so endowed with the special vital characteristics of the parts by which they are generated that in each part they secrete a substance which is similar to the part removed, while the granulations themselves are progressively absorbed (§ 135, *b*). Doubtless, also, the granulations are specifically different, in a physical sense, in all the cases, differently organized, and therefore, as in all other cases of organized lymph, derive their vessels from the parts by which they are generated (*Med. and Physiolog. Comm.*, vol. ii., p. 354–362).*

The cavity being filled, the granulating process ceases, as if instinctively, and a new one sets in, by which the granulations are covered with a substance analogous to skin, and which is called the *cicatrix*. This completes the series of Designs attendant on the different stages of an abscess, and which exemplifies all the regular stages of inflammation (§ 729, *b*).

733, *d*. Who shall resolve the foregoing wonderful processes and results, their exact concurrence, their obvious design, their great final cause, by any process or laws of the inorganic world? Yet is even this now almost universally attempted! Such is ever materialism! But, when it will not listen to the voice of Nature as it proclaims her Author, we may hope in vain for any interpretation of her phenomena that may recognize dignity or design in her minor aspects, and least of all as it may conflict with the fundamental principle of materialism. When error is bold in its demonstrations it is reckless of consistency, and therefore regardless of facts (§ 5¼, 5½, 40, 80, 117, 137, 143, 155, 156, 169 *f*, 172 *b*, 226, 303¼ *a*, 306, 310, 311, 350¾ *g–o*, 376½, 384, 385, 387, 399, 409 *f*, 422, 500 *n*, 514 *h*, 524 *d*, 525, 526 *d*, 528 *c*, 638, 649 *d*, 733 *b*, 764 *b*, 811, 847 *c*, 848, 902 *f*, 905, 943 *c*, 980, 1019 *f*, 1085).

733, *e*. As we have now and before seen, Nature often contemplates a variety of useful purposes in the individual processes she adopts for the benefit of organic beings. The healthy state of the body is full of examples. Every action of every part has commonly more than one definite object; often many. So is it, also, with those morbid processes which are instituted for the restoration of health. As soon as the tendency in diseased actions is set up toward the natural condition, the subsequent changes have a specific reference to the ultimate cure; the completion of which, however, may be very remote from the initiatory step. The vital properties and actions may pass through a variety of changes before they attain the natural physiological condition (§ 672, 676). But each change, each step in the

* Ollier's production of bone by the transplantation of *periosteum* is a good illustration of thi subject.—1860

process, may be necessary to the next succeeding, till Nature attains her normal condition. This, however, is only one part of Nature's plan in her salutary efforts to escape from disease. She renders various results, as she goes along, instrumental in bringing about the subsequent steps in the process of cure, and even associates with these other useful objects. In the case but just before us, while ulceration is making its way to the surface for the discharge of matter, the purulent formation is constantly subduing the inflammation, and the secretion of lymph, which is designed for agglutination and granulation, has the same salutary influence upon the morbid process on which its production depends (§ 764, *e*).

The properties of life are thus constituted in such a manner as not only enables them to undergo changes from their diseased to healthy states, but, through their instruments of action, to result in the formation of products which shall contribute to this great ultimate end (§ 672, 733 *d*, 761). This is the philosophy of the *vis medicatrix naturæ*.

733, *f*. The foregoing law of *reparation* prevails universally in organic beings; extending, therefore, to the vegetable kingdom. It appears, however, under various modifications, even among the animal tribes. It is presented in its most simple form in the growth of divided polypi, the reproduction of the claws of lobsters, of the lizard's tail, &c., when it takes the name of *regeneration*. But, it is equally an act of regeneration when ulcerated parts are restored in their former organization by the granulating process. The difference consists alone in partial modifications of a common action (§ 733, *b*). In the regenerative and reparative processes of plants the difference is still greater; and such as reject analogy, or cannot discern its light, have argued that the differences depend upon essentially different laws. A previous inflammatory action, it is true, is necessary to reparation in the higher order of animals, but is not necessary to the fundamental law as it is concerned in the regeneration of entire parts in the lower animals, nor in the reparative process of plants. The properties of life are differently modified in each, and consequently the processes differ, though as intimately connected by analogies as the modifications of the simple physiological states (§ 185, 672, 688 *ee*, 733 *e*). Nor is the granulating process an inflammatory one, but only consequent on that pathological condition; while the simple production of lymph may be a direct emanation from inflammation, or only consequent on its decline, or on a near approximation to that mode of action. All the modifications, however, give rise to corresponding varieties in the nature of the lymph, just as they do in that of purulent matter. They may offer to our inadequate vision the sameness of appearance that is presented by the pus of an abscess, or of a chancre, or of small-pox, or appear as identical as the granulations of every part. The last, indeed, are the things in question; and although their ultimate results supply an unerring test, it is only coincident with all the others, and even with that which is offered by the natural states of the different tissues (§ 22, 42, 48, 53 *b*, 133, 135 *a*, 409 *e*, 411, 739, 740).

By thus pursuing the inquiry, the various results will be found connected by close analogies, though the extremes may be stumbling blocks to the careless. The periodical regeneration of the stag's horn, where some of the most characteristic marks of inflammation

are present, forms an intermediate example. But the deer, in other respects, is as limited as man, or other animals of the same complex organization, as to the principle of reparation. In all such animals, the amputation of a limb, or the removal of any important organ, is never followed by a regeneration of the part. Such parts do not embrace, like the parts of a polypus, or of a plant, the organization that is necessary to constitute a whole. Nevertheless, the law obtains, even here, to a remarkable extent. If the middle of a bone be removed, it is regenerated. But there must be opposite surfaces, and the right action must be instituted in each surface, as when the opposite pleuræ unite. In the same way central portions of the muscles and nerves may be removed and regenerated; and the process by which this is accomplished is the *granulating*.—*See* p. 473, *note*.

733, *g*. This leads me to notice a fallacy of the physical philosophers, who have been led into the error, as in most other cases, from neglecting, if not altogether the vital properties, at least their natural modifications as they exist in vegetables, and in the different races of animals (§ 133–163, 185). With this neglect of fundamental principles, and a substitution of chemical and physical laws (§ 5¼, *b*), they have endeavored to array an argument against the Hunterian doctrine of the dependence of the union of wounds, by the *first intention*, upon inflammatory action, by identifying the process of reparation in vegetables with the union of incised wounds. Reparation in plants, say they, is not an inflammatory process, and, therefore, the effusion of lymph in the incised wounds of animals is not connected with inflammatory action; and they endeavor to fortify this reasoning by an appeal to the regenerating power of the polypus, the lobster, &c. As well might we argue that vegetables, and polypi, should be subject to the same diseases as man or quadrupeds, or that all animals should live alike upon the same kinds of food (*Med. and Physiolog. Comm.*, vol. i., p. 696–698).

733, *h*. The same objectors, however, set aside, on other occasions, some of the plainest and most important analogies of nature. They maintain, for example, that the functions of nutrition, secretion, &c., are carried on in all animals mostly through the nervous system, but are compelled to take a very different ground for the same functions in plants (§ 350, no. 18–20, 62, 63, &c.).

The nervous system, however, being superadded to animals, modifies greatly their common properties and functions of life, expounds, in part, the differences and special analogies in the foregoing processes of *reparation, regeneration*, &c.; and being a superaddition to animals, and a large, however unintelligible element in the doctrines of the physical philosophers of life, I formerly employed it as the ground of an analogical argument that the principle of life was originally superadded to animals after the creation of their structure.

733, *i*. Consider, also, the parallel which holds between the morbid growths that are induced by special injuries of the animal and vegetable organization. Take an example of the latter in the nest of the Cynips quercus folii; and how evident is it, from this simple fact alone, that both departments of the organic kingdom are endowed with the same organic properties and functions, alike liable to disease, and governed by analogous laws (§ 185, 191 *a*, 409).

All the foregoing may be farther illustrated by what I have said in

a former section of inflammation in its connection with child-bed women, &c. (§ 688, *ee*).

733, *k*. It is certainly remarkable that such obvious analogies should strike different minds under such different aspects, and doubtless many will think it superfluous that misapprehensions of the foregoing nature should receive a formal refutation. But they are sustained by minds that have a powerful influence, and must be respected. It is so, indeed, with the delusions of imagination itself; and were not a certain degree of resistance opposed to animal magnetism, its votaries would trespass far upon the domain of physiology, and trample without remorse upon universal knowledge.

Irregularities of Inflammation.

734. The regular stages and results of common inflammation which have been now described are subject to various irregularities, which spring from innumerable causes, but especially from morbific influences propagated from the organs of digestion. A great variety of modifications are also attendant on the specific forms of the disease; when the special results are apt to be mostly due to the nature of the predisposing cause. At other times, and in numerous cases of common inflammation, certain effusions, such as coagulable lymph and serum, which are equivalent in principle to the suppurative stage, appear to be regular stages. But they so often run into each other, that it is more philosophical to regard suppuration as the elementary process.

735, *a*. Instead of the progressive stages of inflammation, the disease may terminate in *resolution*. This result is generally intended to embrace one of the common products, coagulable lymph; the name and mode of termination coming to us from the humoral pathology. But, according to the philosophy which I have endeavored to set forth, I reject both the "concoction of humors" and the effusion of lymph, and mean by the term *resolution* a simple restoration of the morbid properties and functions of an inflamed part to their natural state, without any other supervening result beyond the *formative* stage (§ 729, *b*).

It is a primary object of art to anticipate nature in her depletive course, and thus prevent inflammation from passing beyond its incipient stage. It is here that the advantages of art are strikingly illustrated; since unaided nature proceeds to the cure by effusions of lymph, pus, serum, &c. (§ 732 *d*, 863).

735, *b*. Inflammation frequently advances in its formative stage without being circumscribed either by effusions of lymph, or by other causes, and it is then *diffuse*. This irregularity is apt to attend upon some tissues more than others, especially the venous, lymphatic, cutaneous, and serous. There are also certain striking facts relative to diffuse inflammation which go to illustrate important physiological laws. Thus, in erysipelas, it is apt to be symmetrical upon both sides of the face. In phlebitis, the inflammation is often limited to the divergence of a vein (§ 741, *c*). In small-pox and kine-pox, the inflammation extends only a certain distance around the pustules, though not limited by the adhesive process. And here we may notice one of the various demonstrations of a law expressed in § 149, in the manner in which the sinapis, cochlearia, rhus vernix, &c., produce *diffuse* in-

flammation of the skin (§ 649, *c*). Each of all the cases, and thousands of parallel examples, each as a whole, or in its details, supply so many problems for the profound inquirer, reveal the apparent mysteries of life, and stamp their seal upon the doctrines I have taught (§ 133–163, 177–184, 188–192, 651–657, &c.).—NOTE T p. 1125.

736, *a*. Opposed to the termination of inflammation in resolution is that of *mortification*, which is the greatest irregularity of the disease. Mortification, also, like resolution, commonly happens in the *formative* stage. This result also takes place, in most instances, when that stage has reached a very high intensity. Exceptions, however, as to the force of the disease, occur in dry gangrene, in the gangrene of old men, and in white gangrene (*Med. and Physiolog. Comm.*, vol. ii., p. 319, &c.). Irregular effusions are more or less attendant on this mode of termination.

736, *b*. What is the cause of mortification? It can be only said of it, that there happens a profound alteration of the properties and actions of life which results in their extinction, and that this change is of a vital nature and not dependent on mechanical causes, as supposed by the physical theorists, unless the circulation be artificially interrupted, and as practiced by these theorists with a view to an interpretation of a natural process. But this mode of death is as easily comprehended as that from fever, or hydrocyanic acid, &c. (§ 54–56. Also, *Med. and Physiolog. Comm.*, vol. ii., p. 171–173).

736, *c*. By what process is the dead removed from the living parts? Here, again, we have, from most physiologists, a mechanical rationale which shall be consistent with the more important steps in their philosophy of inflammation. The dead parts, say they, are removed by the impulse of the *vis a tergo*. But I apprehend the process to be exactly the same as that by which a thorn is removed from a living muscle, or a scab from an ulcer. Each is, in the same relative sense, a foreign body, and each brings into operation, for its own removal, the laws which are represented in section 733. The dead part, like the thorn, excites inflammation in the surrounding tissues, suppuration and ulceration set in, the absorbents carry off the portion of the living matter contiguous to the foreign bodies, and thus is their separation effected. The process of granulation completes the cure (*Med. and Physiolog. Comm.*, vol. ii., p. 167–172). Or, turning to the analogy supplied by the vegetable kingdom, will it be surmised that the removal of the dead parts of plants depends upon the mechanical action of a *vis a tergo?*

737. Another irregularity of inflammation respects the period of its different stages, one or more of which may be accelerated or protracted beyond the ordinary time. This is often true of the *formative* and *restorative;* and since the formative may be long continued, and then result in resolution, we see the importance of holding morbid anatomy subordinate to the vital signs of disease.

The *restorative* process varies, also, as to its *course*. Granulations sometimes fail of approximating a level with the skin, when the true cicatrix may fail of being formed, and in the place of it appears a scabby substance, or some other imperfect formation, and often readily liable to absorption. At other times the true cicatrix is suddenly removed, the granulations absorbed, and the ulcer reproduced.

738. *Scirrus* is another distinct irregularity of inflammation. Here

the action is modified in a very remarkable manner, and is obstinately retentive of that peculiar modification. It is so far analogous, however, to common inflammation, that some of its worst results are an effusion of coagulable lymph, and destructive ulceration. It has been lately denied by the physical theorists that scirrus is an imflammatory affection (*Med. and Physiolog. Comm.*, vol. ii., p. 321–330).

739. The products of the second stage of inflammation, pus, lymph, or serum, are liable to deviations; denoting special modifications of the pathological conditions upon which they depend (§ 733, *f*). Besides the obvious and well-known variations from the proper pus of common inflammation, there are other varieties which neither sense nor chemical analysis can detect; as in small-pox, and lues. It presents, also, certain obscure peculiarities according to the nature of the tissue by which it is generated (§ 133–137); and this is also true of the morbid production of serum (*Med. and Physiolog. Comm.*, vol. ii., p. 197, 198).

740, *a*. Every variety of product has its special pathological cause, which it is the great end of art to comprehend. It is the best observation ever made by Andral, that,

"We are not to suppose that the qualities of the purulent secretion are affected by causes which operate locally. The qualities are likewise modified by every alteration, whether physiological or pathological, which takes place in any other organ, no matter how far removed from the seat of the suppuration, even though it have no particular connection either of function or tissue. Thus, we have all seen instances of the pus secreted by the surface of a sore becoming suddenly altered in quantity and quality, under the influence of a simple moral emotion, of the process of digestion, of the diminution or increase, whether natural or artificial, of any of the secretions, or, in short, of any supervening disease. Nay, farther, there are certain constitutions, certain idiosyncrasies, which modify the qualities of pus, and in which it constantly assumes a peculiar and determinate character. There are some persons, for example, whose organs, when irritated, never furnish any other than a thin serous fluid; in others it is always blood more or less pure which is secreted; while in a third class of persons the place of pus is supplied by a grumous fluid," &c. (§ 134, 135, 222–232, 500, 585, &c., 593, 732, 733 *f*, 830, 847 *d*).

Thus have I quoted from Andral a luminous confirmation of my doctrines of vital action, of alterative nervous influence, direct and reflex; and I have adopted it on account of the force which it derives from emanating from a physical theorist of disease, and the distinguished restorer of the humoral pathology.

740, *b*. Nor have I yet quoted all from Andral that is expedient, in this place, on a subject where vitalism and solidism may establish their firm foundation; and this, too, by the most absolute, unguarded concessions from the opposite school.

Let us hear, then, once more, the great modern humoralist. Thus:

"All attempts to modify the qualities of the suppuration by local treatment, in scorbutic and scrofulous subjects, are utterly ineffectual; for it is the system at large, and not merely the suppurating surface, which is deranged in nutrition and secretion. We must commence the treatment by endeavoring to modify the whole process of nutrition, innervation, and hæmatosis."—And again: "We do not know what

the peculiar modification is which the texture of an organ undergoes, so that in one case it allows the blood determined toward it to escape from its vessels; in another it forms pus, or exhales only a thin serum; while in a third, it becomes indurated, softened, and ulcerated; but *there is a common link which unites these different alterations;* and hence it is, under the influence of apparently the same cause, we often see them produced indifferently, *and not unfrequently replaced one by the other* (§ 732, *a*). But, in all this series of phenomena, we can perceive, throughout the whole course of the disease, *one constant lesion*, namely, the *hyperæmia*, and a succession of morbid alterations in the organic action of the tissue affected, producing, alternately, the results already mentioned" (§ 672, 733 *e*, *f*).

Here, then, are pure vitalism and solidism, because the writer was specifically concerned about matters of fact. The same principles, exactly, apply to all other actions and results which deviate from the natural condition of the body (§ 64, 345–350, 350$\frac{3}{4}$ *n*, 699 *c*).

741, *a*. Again, here is another important practical and philosophical fact, which distinctly evinces the dependence of all the foregoing conditions, changes, &c., upon purely vital actions. A suppurating surface may be so affected by *constitutional* influences, by disordered digestion, that the same results may follow as when the change is produced by some *local* irritant. This proves that the modifications of pus, and therefore pus itself, are not owing, as commonly maintained, either to a degeneration of the blood, or of the tissues, or even to changes of organization, but to certain modifications of the vital properties by which organization is animated; since it would be absurd to suppose that indigestion, and some caustic or other irritant applied to the ulcer, would determine the same physical changes.

741, *b*. From what has been now and before seen, we may insist upon one of the most important conclusions in medical philosophy, which strikes at the whole foundation of humoralism, and is unsurpassed in its practical bearings. We may conclude, I say, that when serum, or lymph, or mucus, are diverted from their natural condition by disease, that the modification depends, in each instance, as much upon certain special physiological changes as do their natural states upon the natural condition of the solids. This analogy prevails throughout all other natural products of an organic nature, when turned from their common standard; and were there no other facts, the analogy would establish the same principle in relation to all new formations, as pus, &c. But, such facts I have multiplied abundantly in another work. All the varieties, every shade of difference, arise from modifications of action which are always necessary to the several varieties, respectively. The vital properties must be so modified in the several cases that the capillaries, acting in obedience to these properties, shall decompound, and recombine, the particular elements and constituents of each product, and in their proper ratio, and modes; rejecting all the rest. Otherwise, indeed, there could be no resemblances among the natural or morbid products, no gradations from one to the other, no obvious coincidence between certain morbid lesions of the solids and the resulting products. Every thing would be confused; there would be nothing but the riot of the chemical forces; and even empyricism would look on in dismay. The physical theorists, therefore, are forever involved in inconsistencies

excepting their universal collision with facts, and suiting hypotheses to each particular occasion (§ 42–52, 409 *d*, 694$\frac{3}{4}$).

But the properties of life can never undergo any change of their essential nature till they are verging toward a state of extinction. Hence the analogies among diseases, according to the nature of the remote causes. It is a great foundation of the healing art; and were it otherwise, medicine would be utterly fruitless, a mere creature of circumstance, one perpetual experiment (§ 638, 780).

The considerations which I have now made enforce, particularly, a critical reference to the pathological conditions in all our prescriptions, their seat, the influences which surround them, the precise adaptation of remedies as to their nature, dose, time and order of their exhibition, &c. They demonstrate, also, the distinction among remote causes of disease, especially such as have their origin in morbid or healthy processes of living beings, and establish the fact that the same disease cannot be produced by the products of organization and of chemical decomposition (§ 653).

741, *c*. We may now glance at one or two important facts connected with the foregoing subjects. Thus, it is important to bear in mind that it is the tendency of inflammation to confine itself to that tissue in which it springs up, along which it is propagated especially by continuous sympathy; though exceptions often occur (§ 133, 141, &c., 498, 500). What is true of inflammation in this respect is probably, also, of other morbid states. The reason is to be found in the natural modifications of the vital properties of the different tissues. This modification existing in different parts of one and the same continuous tissue commonly limits the continuity of inflammation to a particular part of the tissue, though it often spring up in other parts of the tissue by reflected nervous actions (§ 134, &c., 500, 674 *d*).

The foregoing general limitation of any given form of disease to the tissue first invaded (excepting as other tissues of the same compound organ are more or less disturbed in function) is especially remarkable of the *common* form of inflammation, and of diseases that are not distinguished by obstinate conditions, such as specific inflammations with strongly-marked characteristics; as scrofulous, venereal, carcinomatous, &c. (§ 149–151, 525–531).

REMOTE CAUSES OF INFLAMMATION.

742. The remote causes of inflammation fall under the general considerations already made (§ 644–666). As all the agents which contribute to its production must be included in the category, such as are naturally salubrious, or necessary to the purposes of life, as food, &c., sometimes fall within the comprehensive class. It is mostly, however, the abuse of such agents which renders them predisposing causes; but they may readily prove exciting when other causes have laid the foundation of predisposition.

743. It only remains to be added upon this subject, that I cannot agree with distinguished vitalists that stimuli are alone the predisposing causes of inflammation and fever; but there can be no doubt that a right decision of the question is of practical importance. Upon it may depend, for example, the proper treatment of cerebral affections arising from excessive doses of opium. In excessive doses, it is generally conceded to be directly sedative; and yet is profound

cerebral congestion one of its morbific effects, for which bloodletting is the most efficient remedy. Hydrocyanic acid will do the same thing, which, in like manner, is best relieved by loss of blood (§ 483, 484, 494 *dd*, 827 *d*, 828). And so of extreme cold, the philosophy of which is set forth in the Commentaries (vol. ii., p. 478–493.) Tartarized antimony is powerfully sedative in all its doses, and the larger the more so. Yet in its over-doses it produces a serious form of inflammation. Even excessive bloodletting may lead to inflammation, for which the farther abstraction of blood by means of leeches may be useful, or at least so it is said (§ 1024 *a*, 1057).

Concentrated miasmata, when followed immediately by an attack of fever, evidently depress the powers of life, as one of the first changes which they establish (*Commentaries*, vol. i., p. 471–474). We must take the facts as we find them, and build our theories accordingly. And here we see the importance of looking well to the characteristics of the properties of life, at their wonderful mutability, observe how they may be profoundly altered at the moment when certain morbific causes begin to operate, how they may go down in an instant to a state of extinction; and how, on the other hand, every restoration from disease is the result of their own constitutional tendency to return, through a series of changes, suddenly or gradually, to their natural state (§ 175, 177–185, 672, 733 *e*).

These considerations enable us to understand how the properties of life may be as readily affected by depressing agents or sedatives as by stimulants, and how, when affected by the former, they may speedily react and constitute the absolute conditions of inflammation and fever (§ 666), or return at once to their natural state (§ 150, 151, 227). When either of these morbid conditions actually ensues, there can be no doubt that the organic properties have undergone an exaltation as well as another modification in kind. The physical philosophers will allow nothing but absolute prostration, and a passive relaxation of the vessels, when high arterial action sets in; but they look upon the cold stage of fever as being best explained by something like the "glacier theory." And yet, if we go to the simple facts attendant on the very invasion of fever, we shall find in the universal contraction of the capillary vessels, during the cold stage of fever, abundant proof of the exaltation of mobility and irritability; and this is farther confirmed by the salutary effects of two most depressing agents, bloodletting and emetics. See, too, how local inflammations are becoming generated during this stage; and when the hot stage supervenes, and when, also, in progressive order, the secretions break forth, we have the most unequivocal demonstrations of exalted powers; though here, as in inflammations, this change is only an inconsiderable part of the alteration which the properties of life sustain (§ 188½, 487 *h*, 569, 675, 764, 964).

Still, however, in respect to inflammation, its most common causes are directly stimulant, and exalt the vital properties and actions by their direct operation; but this appears not to be equally true of idiopathic fever (*Med. and Phys. Comm.*, vol. ii., p. 213, 241–248, 277–280, 288, &c.).

Finally, we may not lose sight of the fact that the nervous influence, either reflex or direct, is the immediate remote cause of effects beyond the seat of the direct action of the primary causes (§ 647½, 666).

PATHOLOGICAL OR PROXIMATE CAUSE OF INFLAMMATION.

744. "The act of inflammation," says Hunter, "appears to be an increased action of the small vessels. It is commonly supposed to be contraction of the vessels; but I have shown that their elastic power also dilates them, and I have also reason to believe that their muscular power has a similar effect."—HUNTER, *on the Blood*, &c.

"The blood," says Magendie, "traverses with ease the infinitely more minute tubes that abound in our tissues. There must be some particular conditions to facilitate its passage. What proves their existence is, that if certain alterations are effected in the composition of the blood, it stops, undergoes morbid changes, becomes extravasated and decomposed, and *produces the various disorders* which pathologists have vainly attempted to explain by the words INFLAMMATION and IRRITATION. What sense, in truth, is there in applying the word *inflammation* to our organs? Do our tissues actually *take fire?*" [So says Vacca, and Magendie is of his school.]—MAGENDIE, in *London Medico-Chirurgical Review*, January, 1839, p. 208.

"For my part, I declare boldly, that I look upon these ideas about VITALITY and the *rest of it*, as nothing more than *a cloak for ignorance and laziness.*" "All the physician can do is to order remedies, which, if necessary, the *nurse could prescribe equally well.*" "You saw me give rise, *at my pleasure*, to pneumonia, *scurvy*, *yellow fever*, typhoid fever, &c., not to mention *a number of other affections which I called into being before you.*"—MAGENDIE'S *Lectures.*—And that, too, upon animals.

"Pythagoras," says an ancient philosopher, "looks at the sun very differently from Anaxagoras. The former carries his eyes into it like a god, while the latter looks up to it as unfeelingly as a stone" (§ 699, 709, 810, 838.—Also, *Medical and Physiological Commentaries*, vol. i., p. 510–515, text and notes, 518, note, 526, 539, 567, note, 584, 611, 650, notes, 697, 698, as to *Magendie.* Also, *Lehmann*, § 1034).

745. No subject has excited more discussion, or more deservedly, than the pathological cause of inflammation, since this affection and idiopathic fever comprise most of the diseases of man, and since, also, the treatment of disease turns mainly upon our conceptions of its pathological character (§ 4, 667–677).

The example of inflammation involves the whole philosophy of all other diseases; and, if our views be right in respect to this affection, we shall have little difficulty with any other. This I shall endeavor to show by a special consideration of fever and venous congestion. The general laws are the same in all the cases; though the results are variously modified. There may be, for instance, in one form of disease increased action of the extreme vessels, an exaltation of the vital properties, &c., while in another form an opposite condition may obtain. Yet these opposite states shall depend upon the same great general laws. In either case, for instance, it is a general law that an altered condition of the organic properties constitutes the essential pathology; and, it is another general truth that this altered condition has been instituted by deleterious agents. The changes in function will also correspond with the particular changes of the organic properties. But, coming to the details in respect to the exact nature of the changes, we find them different in the different cases; and they

depend mainly upon the specific nature of the remote causes, which have altered the properties of life in one series of cases in a different manner from the other series (§ 652). These, therefore, are only contingent results, and do not affect the great laws which are concerned about the essential pathology of disease.

746, *a*. The extreme terminating series of the arterial system of vessels are the immediate instruments of inflammation. They are endowed with muscular fibres, and perform, naturally, the function of active contraction and dilatation (§ 384–387, 397–399). That such are the essential instruments is evident from a variety of facts, of which, however, it is only necessary to state one, namely, the analogy which subsists between the process of nutrition and the reparative process of inferior animals and the formative and adhesive stages of inflammation; while the true suppurative, and all its modifications, are analogous to the general function of secretion (§ 729, 732 *a*). The effect of cantharides, &c., applied to the skin, is an example in illustration. All this, too, corresponds exactly with what is known of the greater development of the properties of life in the extreme vessels; which, it may be now said, supplies an important proof of their increased action in inflammation (§ 407 *b*, 410, 411).

Such, too, are some of the numerous instances in which we reason with certainty from analogy, especially in relation to organic life; while the conclusions are corroborated by all the relative facts.

I have thus thought it important to indicate with precision the instruments of inflammatory action, that they may not be confounded with that series of capillary vessels which serve mainly as reservoirs to the extreme vessels, and between which there is also a broad distinction in their vital states. We shall have accomplished much in establishing the vital character of inflammation, and in exposing the errors of the physical hypothesis, by the plain fact whose statement is made as a point of departure and for the government of the whole inquiry. Those vessels, as I have endeavored to prove, are eminently characterized by the attributes of life, and I hold it to be fundamental, and cannot be denied, that what is physiologically true is true, also, of those morbid states which coincide in their general results with the physiological (§ 41–44, 48, 52, 134, 135, 136, 409 *c*–411, &c., 516 *d*, no. 6, 524 *a*, no. 1, 526 *a*, 1039, 1040, 1056).

If such, therefore, be founded in nature, the essential philosophy of inflammation is to be found in modified states of the natural properties and functions of the extreme series of the arterial system.

746, *b*. The absorbents, also, are interested in the ulcerative process, and are, therefore, modified in their action.

746, *c*. The nerves, from constituting a part of all the tissues, and from the liability of every part to be affected by preternatural determinations of the nervous power upon them, and being, also, the organs of sensibility, are so far liable to a participation in the pathological states of inflammation, and in affecting the secreted products (§ 456 *a*).

From all that has been said, it is evident that the nervous power can act only as a remote cause of morbid changes, and that the conclusion is unavoidable that all the remote causes of inflammation, as of every other disease, produce their morbific effects upon the organic properties, that the morbid processes are carried on by these properties, as in the vegetable kingdom, and that the nervous system is not

necessary to the disease, however it may exert a profound influence both upon the actions and products (§ 227, 233⅘, 475½, 507, 647½).

The nervous power, it is true, is the immediate remote cause of all inflammations which spring up sympathetically, but it forms no part of the essential pathological cause; nor are the nerves in any other way the medium through which inflammations are excited (§ 201–204, 226, 233, 405, 446 *a*, 500, 647½, 715, 725 *c*, 902–905, 1039, 1040).

On the other hand, the physical philosophers, with singular inconsistency, maintain that the "nervous influence" has an important agency in the inflammatory process, though they do not say in what that agency consists, or how it co-operates either with mechanical or chemical agencies (§638½).

747. Hunter laid the foundation of the true theory of inflammation. He supposes that the vessels are in a state of increased action, both as to contraction and dilatation, and that, in a general sense, they carry an increased quantity of blood.

Irritability and mobility, the two great properties upon which organic actions mostly depend, are probably always increased and otherwise variously modified in all inflammations. In consequence, also, of the increase of irritability all inflamed parts are more than naturally susceptible of the action of stimuli, though not according to their ordinary effects in health. It is a general law, indeed, in respect to all diseases, that the natural relations of the affected parts to physical and mental agents are more or less altered; and upon this turns, mostly, the curative action of medicine, &c. (§ 143, 149–152). It was a radical defect in Hunter's doctrine that he did not consider the altered condition, in their very nature, of the vital properties, but imputed the essence of inflammation to a simply "increased action of the powers of the part." If the hand be plunged into warm water, there ensues an increased action of the vessels, but there is no inflammation.

748. A theory opposed to the foregoing, and now universally adopted by the physical school of medicine, supposes,

1. That the vessels concerned in the process of inflammation are passively relaxed.

2. A progressive accumulation, stagnation, and coagulation of blood within the vessels (§ 789).

3. An enlargement of the collateral vessels proportioned to the redundancy of blood transmitted to the part, occasioned by the force of the *vis a tergo*.

4. That the blood is propelled through the collateral vessels by the action of the heart (§ 392).

5. That the vessels, being paralyzed, relaxed, and mechanically obstructed, can perform no part in generating the products, or in those processes already described as the results or "terminations" of inflammation; but, on the contrary, that all the fluids are mechanically strained off from morbid blood, notwithstanding the mechanical obstruction occasioned by the coagulation, and that ulceration is only a mechanical softening of the living solids. (See "*Report of the recent State of Knowledge of the Nature of Inflammation*," by Mr. Wharton Jones, in British and Foreign Medical Review, April, 1844.)

749. Such is the prevailing mechanical doctrine of inflammation, which, in conformity with the plan of this work, I have here intro-

duced as appearing to me the most adverse to facts and philosophy, but sustained by a powerful school. I shall not enter upon its farther refutation, nor upon the proof of the vital theory, beyond the statement of a few prominent facts. Both of these objects I have endeavored to accomplish in the *Medical and Physiological Commentaries*, nor have I seen any fact whose import is not there considered (vol. ii., p. 141–214, 224–397. Also, my "*Introductory Discourse*," p. 22, &c., 1842, in vol. iii.).

The mechanical doctrine of inflammation has grown out of experiments by which Nature is misrepresented. I mean that such is my opinion; but not without its attendant reasons. One experimental fallacy, however, lies mainly at the foundation of all the foregoing conclusions, which consists in the means by which inflammations are artificially produced for the purpose of arriving at a knowledge of their pathology. Irritants of a chemical nature have been applied to delicate membranes, by which their organization is impaired or destroyed, and the blood also coagulated by direct chemical influences. The part has been then subjected to the microscope, under the direct rays of the sun, whose heat has the effect of drying the disorganized tissues, and consolidating the blood. Let rubefacients be a test.

From such most unnatural results the whole organic process of inflammation, its formative stage, the stages of suppuration, ulceration, and the secretion of lymph, of serum, &c., are interpreted upon purely mechanical principles (§ 396, 410).

But, if this were true of inflammation, it should be equally so of the analogous results in the healthy state of the body; and growth itself, and all the secreted products, should be equally determined by mechanical laws. Were the doctrine, therefore, founded in nature, it would completely overthrow the whole science of physiology, and reduce the living being to a mere automaton (§ 639 *a*, 746 *a*).

750, *a*. We have already variously seen what analogy prompts. We have seen, too, that it has been demonstrated that the blood is accelerated in the capillary and larger vessels when stimulants are applied to them, or to the brain or spinal cord, and that they give rise to alternate actions of contraction and dilatation, even in the veins (§ 384, 387, 392, 399, 408–411, 480–485, 498 *e*). We have seen how the extreme vessels become enlarged and admit the red globules (§ 192). We have seen, physiologically, that all the vessels must have an independent vital action (§ 382, &c., 407, 410, &c.). And now I ask the physical philosopher, upon his own ground, how the extreme vessels in dense structures, such as ligament, cartilage, and bone, acquire their great enlargements in their inflammations? It is evident that the physical philosopher has limited his views, as he has his experiments, to soft, delicate membranes. He has reasoned from an isolated fact, and that fact evidently of a spurious nature (§ $5\frac{1}{4}$, *b*, *c*).

That there is generally, though not invariably, an increased volume of blood circulating in the instruments of inflammation, is shown by the increased quantity of blood which flows from the veins of an inflamed part; by the high florid color of the part, and of the blood; by the profusion of blood which follows scarifications and leech-bites; by the rapidity with which the blood returns when expelled, by rubbing, from an inflamed surface; by the actually increased fluidity of the blood proceeding directly from the seat of inflammation, as shown

by its slower coagulation than in health; by the preternatural generation of heat, which even no chemical theory can explain without admitting an increased circulation of the blood; by the profuse secretion of certain fluids, and their specific nature; by the frequently increased pulsation of an artery leading to an inflamed part, and especially as the pulsation is often strongest when the general circulation is prostrate, and again, on the other hand, as the throbbing of the vessel often subsides when the force of the general circulation rises under the influence of the lancet; while the local inflammation may go on increasing, &c. (§ 1056).

750, *b*. Coincident with the numerous physical and pathological facts which lie at the foundation of the vital doctrine of inflammation are the effects of remedial agents; since bloodletting, cathartics, antimonials, and other depressing agents, should increase the supposed relaxation of the vessels, and stagnation of blood, both by their direct action and by diminishing the force of the *vis a tergo;* while, on the other hand, tonics and stimulants should be the prevailing means of cure. Nor can the curative effect of the former agents, nor the morbific of the latter, be interpreted on any other than physiological principles. How, again, will the physical philosopher explain the instantaneousness with which moderate bloodletting, nay, even syncope without the loss of blood, will sometimes overcome pneumonia, inflammation of the brain, &c. (§ 951)? How explain the rapidity with which croup will yield to the prostrating effect of antimonials; or how deep-seated inflammations take their departure as soon as the same condition is produced in the skin by cantharides, or yield more gradually to the silent influences of antimony, ipecacuanha, mercurials, iodine, colchicum, guaiacum, veratria, quinia, &c., according to the special modifications of the disease by its various remote causes (§ 150, 650–653, 662 *b*, 668, 669, 672, 674, 742, 935 *d*, *e*)?

751. I have just intimated that, if vital action do not exist, there should be no varieties of inflammation. It should be all small-pox, or lues, or rheumatism, or, at least, all of the common variety. The vital phenomena and physical products should be always the same; the same in all tissues and in all constitutions (§ 409, *c–i*). Nor should we have any remarkable and diversified sympathetic influences of inflamed parts upon the system at large (§ 500, 512–530). The vitalist supplies the only intelligible solution of the facts which are presented in real life. He points to the various modifications of the organic properties, according to the peculiarities of every tissue, the diversities of the remote causes, constitution, age, sex, &c., which he believes, also, to be the foundation of all rational pathology; and upon the same principles he interprets the curative effects of remedies.

Active and Passive Inflammation.

752. I endeavored, originally, in the *Medical and Physiological Commentaries*, to show the fallacy of the distinction of inflammation into *active* and *passive*, and to prove the dependence of all forms of the disease upon one general pathological cause; and I shall now briefly advert to the manner in which the principles set forth in the present work establish that conclusion.

753. In the *active* form of inflammation there appears to be a vague recognition, so far as the verbal distinction goes, of the morbidly-in-

creased action of the part, while in the passive form all is "relaxation" and "stagnation" (§ 748). These exactly opposite states of verbal pathology are especially characteristic of the school who maintain that inflammation is always constituted by a passive relaxation of the vessels and coagulation of blood. With the same consistency they also affirm that the two nominal conditions require opposite modes of treatment; though, in justice to the real hypothesis, it should be said that the stimulant plan is apt to prevail. There are many authors who speak of an active and passive state of inflammation as things in absolute opposition, but they attempt no explanation of the supposed distinction.

Andral perceived that the term *active* is not in harmony with the mechanical philosophy of the disease, nor with his own views as to the abolition of the general term; and he therefore substitutes *sthenic* and *asthenic* to express the opposite conditions, and *hyperæmia* in the place of inflammation. But the epithets are as much in direct opposition as *active* and *passive* (§ 699, *c*).

754. But it requires only a right exercise of judgment to understand that the same disease cannot be constituted by opposite pathological conditions (§ 741, *b*). The supposition contradicts itself. The varieties depend simply upon partial modifications of a common pathological cause; and this conclusion, as abundantly exemplified, is of no little practical importance (§ 766). The term *passive* can only be intended, by those who use it, to inculcate a stimlant treatment, and that mechanical condition of the blood-vessels whose refutation I have attempted extensively in the *Commentaries*.

755. Again, in the supposed opposite conditions, the vital signs, and the morbid products, are nearly identical; which evinces, sufficiently, a close affinity in the pathological states, while the analogy between those products and such as depend on the natural processes places both modifications of the disease on a common physiological foundation (§ 137 *e*, 150–153, 639, 746 *a*, 694$\frac{3}{4}$).

756, *a*. The occasional success of tonics and stimulants in the treatment of inflammation, whether applied internally or externally, or with or without antiphlogistic remedies, is no evidence, as supposed, of a pathological state manifestly different from that which is most readily surmounted by loss of blood, cathartics, &c., alone. This will be obvious when the true *modus operandi* of remedial agents is duly considered (§ 150–152, 638, 893, &c.). It is also well known that a sudden and powerful impression even from alcoholic stimulants will sometimes subvert an inflammation or a fever of great activity, which, under apparently the same circumstances, would be aggravated by such treatment in the hundred next following cases, but where loss of blood, &c., would be speedily curative in nearly all (§ 900, 904 *d*). The disciples of Brown have been thus enabled to sustain themselves in the midst of general failure.—Note Ee p. 1133.

Take a clear example, which illustrates the only distinction, so far as principle is concerned, between the supposed opposite conditions of inflammation. Such a one occurs in this disease when modified by the predisposing cause of intermittent fever. Here the Peruvian bark may be as necessary to its cure as the loss of blood, though the latter is commonly, also, more important. And there occurs to me a proof from analogy which demonstrates the vital doctrine of inflammation;

which consists in the fact that the Peruvian bark is also a specific for intermittent fever, while, as with inflammations, it will aggravate other forms of fever. If, therefore, it be admitted that there is no "stagnation of blood" in the intermittent and other fevers, it clearly follows from this analogy that there is none in inflammations.

The intense inflammations attendant on scurvy often yield only to such remedies alone as improve the digestive organs, of which tonics may be one; and here we witness impressive demonstrations of the laws of sympathy (§ 500, 512, &c.). And yet in the same conditions bloodletting may be simultaneously appropriate or necessary. Opposite modes of local treatment succeed in burns and scalds; catarrh is often cured by "gin sling;" erysipelas has apparently yielded to the tonic and stimulant practice, though at the hazard of life; and typhus fever, with its train of local inflammations and congestions, divides the medical world into the two opposite systems of treatment.

Again, the most feeble subjects are quite as likely to require the depletive treatment, in grave inflammations, as the robust; and long-continued chronic inflammations have often yielded to a repeated loss of blood where tonics had been employed under the illusive doctrine of passive inflammation (§ 1007 *b–d*, 1008, 1019).—Note Ii p. 1139.

The differences in small-pox, varioloid, and cow-pox, which are essentially one disease, illustrate the principles before us. So, too, do all the varieties attendant on specific forms of inflammation, as measles, scarlatina, lues, rheumatism, &c. Lues yields especially to mercury; rheumatism to colchicum and guaiacum; scrofula to iodine, &c.; and yet the simultaneous loss of blood may be more or less useful or indispensable. The example of tuberculous phthisis is illustrative of our whole subject. A mixed, or even a stimulant, treatment is slow in its destructive effects; and its evils have been, therefore, overlooked in the speculative views which morbid anatomy has suggested as to the nature of the pathological change in which tubercle originates (§ 695, &c.), and in the brown chicken-meat which chemistry has contradistinguished from the white. This morbid condition has been recently and extensively considered non-inflammatory, and as supposed by Louis when the most extensive inflammatory lesions and products have supervened; and it supplies us with another exemplification of the irresistible tendency of theory, true or false, to determine the treatment of disease (§ 4). The antiphlogistic practice has been abandoned. But what are its results? Has the mortality from phthisis diminished? On the contrary, it has most fearfully increased (*Medical and Physiological Commentaries*, vol. ii., p. 622–633, 743–752).—Notes F p. 1114, Mm p. 1141.

756, *b*. However varied may be some of the remedies in the different modifications of inflammation, the general principles of treatment are substantially the same. The incidentally favorable effect of local or constitutional stimulants is no proof that the pathological conditions of inflammation are not closely allied. It only proves their effect in altering the vital properties in such a way as will enable Nature to take on the restorative process. Least of all can opposite principles prevail at different times and in different climates. It has been so from the earliest records of disease. Otherwise, medicine would consist only of an unconnected series of observations. There would be no principles, and of course no science. Medical learning would

be useless, and experience would suit only the present occasion. A new system of treatment would have to be devised for every climate, every constitution, and every reappearance of the same disease.

But Nature is not thus the creature of accident. It is not Nature who is inconsistent, or who operates by conflicting laws. Art may give her this appearance; but still I say, that "Nature can never deceive." It is owing to this consistency of Nature that medicine had long since become a noble science; difficult and concerned about all other sciences, and therefore taking the lead of all others. A science of principles deduced from the phenomena of Nature, and which, with the facts that are known, conduct us with remarkable certainty to facts that are unknown. It is here that well-founded principles enable us to see farther than the senses, and to learn from a single vital phenomenon, from the expression of the eye, the existence and nature of those latent changes which too many can see only when seeing is useless, and bring upon art and philosophy the derision of the crowd (§ 704, 1005½, 1006 *f*–1007 *d*, 1068 *a*–*d*).

A sound principle in medicine is like the calculus in mathematics; and what are falsely called "exceptions to general principles" are nothing more than variations in phenomena, which arise from the instability of the properties of life, and the vast variety of influences to which they are exposed (§ 177–179, 237). These variations may denote only partial modifications of a common morbid action, arising especially from differences in the remote causes (§ 644, &c.); or, they may depend upon the same action affecting different tissues; or upon the morbid condition of particular organs affecting certain other organs, or all others (§ 117, 129, 134, 137, 529, &c.); or, upon age, sex, constitutional peculiarities, and other accidents (§ 335, &c., 570, &c.). And, although there be one leading principle in the treatment of such cases, there are other subordinate ones founded upon the modifications. These are to be nicely balanced, that the governing principle may be properly directed (§ 675). But, it is only men of correct thinking and close observation that can apply these principles. All others will look upon the variations of symptoms from their usual state in any one disease, or upon the differences in the results of an exact methodical practice, as denoting very different pathological conditions, or as constituting "exceptions to general principles;" and "bark and wine" will therefore obtain in numerous cases where bloodletting is the only efficient remedy.

FEVER.

757, *a*. Important distinctions between the two great classes of disease, Inflammation and Fever, have been already sufficiently indicated. The former, as we have seen, is limited to certain parts, while the latter invades the body universally from its beginning. I have reserved for this place, however, a fundamental distinction, which, as a characteristic of inflammation, has been described. This consists of the morbid products, new formations, and lesions of structure, to which inflammation gives rise. It is otherwise with fever, whose distinguishing phenomena are mostly of a vital nature, and whose morbid physical products consist only of modifications of the natural secreted fluids (§ 764, *e*). Morbid anatomy, therefore, reflects no light whatever upon the pathology of fever. And yet is its treatment, all

its varieties, as well ascertained as that of inflammation and its varieties. Indeed, of most of the varieties of inflammation morbid anatomy does not afford the least information; and yet is the specific treatment of the most common and important, such as rheumatism, gout, intermittent, scrofulous, &c., as well known as the general remedies for inflammation. And so with the varieties of fever. I say again, therefore, that the morbid anatomist may not appropriate what so eminently belongs to the acumen of genius in its philosophical observation of the phenomena of nature (§ 695, &c.).

It is plain, therefore, that all those who would render morbid anatomy the principal basis of pathology can have no definite views of disease. The effects are mistaken for the cause; and if the former be not present, the case is regarded as inscrutable in respect to its pathology. Every disease is, of course, to the morbid anatomist circumscribed to the organs which tell upon his senses; the varieties in inflammation are overlooked from their want of tangible distinctions; and as ulceration, and some other lesions of inflammation, may happen to appear red or white, they are denominated, as by Louis, inflammatory or contra-inflammatory.

757, *b*. Many of the ordinary and most characteristic symptoms of inflammation are wanting in fever; such as hardness and incompressibility of pulse, buffing and cupping of the blood, local pain, &c. This is very obvious in intermittent fever. Exalted heat probably takes place in all inflamed parts; but a sunken temperature is common in fever (§ 712–722). Reflex nervous actions supply a test (§ 720, 893).

758. Fever, like inflammation, has numerous modifications, as a necessary result of the constitution of the vital properties, the variety of morbific causes, the unequal distribution of the disease, &c. These modifications have given rise to the distinctions of *continued*, *intermittent*, *remittent*, *typhus*, *nervous*, *bilious*, *yellow fever*, *plague*, &c. But strong analogies prevail among the whole; the general pathological cause, as in inflammations, being essentially the same. Most of the varieties in fever depend, indeed, more or less, upon the modifying influences of coexisting inflammations and venous congestions, though more so upon the predisposing causes, while, also, the modifications which grow out of these local affections will depend much upon their particular seat. Some organs, also, sustain a greater burden of the febrile disease than others; and this, of course, will give to every case certain peculiar modifications (§ 134, &c., 644, &c.).

759. Fever, in its most simple form, is of short duration, never continues three days, rarely longer than twenty-four hours, and sometimes terminates within four hours. This is the *ephemera*, which may be taken as the type of the complex forms that consist of a series or repetition of paroxysms.

The foregoing may be also noticed as a broad fundamental distinction between fever and inflammation; since the ephemera, a perfect representation of fever, may sweep through its course, and terminate as suddenly as it invades the body, and in less than twelve hours, and leave scarce a vestige of its former presence behind.

760. If fever, therefore, be continued beyond a single paroxysm it is made up of a succession of paroxysms. Many have supposed that every compound case consists of as many fevers following each other as there are paroxysms. This, however, is not pathologically true;

since the same morbid predisposition in which the first paroxysm originated remains, and is the cause of each succeeding paroxysm, and, therefore, a connecting link among the whole. The supposed distinction consists only of periodical abatements of one continuous disease (§ 514 *g*, 516 *d*, no. 6, 665, 666).

761, *a*. The foregoing abatements of fever are the results of salutary efforts of nature, and are variously pronounced as to their degree and duration (§ 733). They are most perfect in intermittent fever, in which they vary from a few hours' duration to one or more days (§ 675).

761, *b*. These abatements of fever, often amounting to an apparent termination of the disease, supply a fine illustration of the recuperative nature of the properties of life, and of their inherent tendency to maintain themselves in a state of integrity. We see, too, the *modus operandi* of art in its use of physiological laws, when, by the interposition of remedies the natural abatement of fever is confirmed by new influences that are different from the original morbific ones (§ 675, 897, 898, 901, 237, 239, 447 *b*, 639, 839, 854, 856, 900, 905).

762, *a*. Each paroxysm of fever consists, in a general sense, of a certain succession of symptoms, which, however, are liable to great variations; and new ones that may spring up in the progress of disease, from accidental influences, may present a general aspect more widely different from the preceding than the near identity of the pathological cause would lead us to suppose. These differences spring from the very susceptible nature of the properties of life, especially in their morbid state, and the various new influences which may operate upon them; and the manifestations are liable to exceed the ratio of any change that may be wrought in the vital conditions. A slight change only, some error in diet, by instituting morbific reflex nervous actions, may give rise to new and striking phenomena, or they may be forcibly presented by the transient effect alone of some momentary cause, as an emotion of the mind (§ 740, 1067).

762, *b*. In presenting a summary analysis of fever, I shall first consider the *Ephemera*. Secondly, fever as constituted by a repetition of the same paroxysm, and in different modes. Thirdly, the remote causes of fever, the coexisting inflammations, &c. Fourthly, the pathological cause.

763. The *ephemera*, as I have said, may be taken as the general type of the entire family of fevers. It generally commences between six or seven o'clock in the morning, or five or six in the evening; a coincidence of difficult explanation, but manifestly connected with some natural periodical mutations in the vital states of the system (§ 768). It has three distinct stages, which are commonly present; namely, the *cold stage* or *cold fit*, the *hot stage*, and the *crisis*.

764, *a*. The first, or cold stage, is the period of the most intense morbid action. Its invasion is marked by a sudden contraction of all the capillary blood-vessels, and consequent determination of blood about the right cavities of the heart, by a diminution of the fluid products, by reduction of temperature, and by a loss, in various degrees, of the voluntary control over the muscles. These are the most obvious changes; and such as relate to organic life evince a universality of the disease at its invasion. Here we may stop to observe another broad distinction between fever and inflammation; since the latter

does not begin in the foregoing manner, but with an enlargement of the capillary blood-vessels (§ 712, &c., 757, 759, 770).

In idiopathic fever, many of the prominent, but less important, vital symptoms, so far, at least, as sensation is concerned, appertain to the organs of animal life. Those of the organic system are less remarkable at first, as natural sensibility is here inferior to its condition in animal life. The eye, for instance, is naturally more sensible than the intestines, and hence an affection of the former is more conspicuous than of the latter, till disease, at least, may develop the property in the intestine. The same rule, in a general sense, will hold as to the individual organs in either division of life, at this early stage of fever, and is applicable to all other diseases. There may be more disease in one organ than in another, yet the symptoms of that which is most affected may be less strongly pronounced on account of its natural inferiority in *sensibility*, and often, also, of *irritability* (§ 133–139, 188, 194).

A preliminary condition, subsequent to the formation of the predisposition, and immediately antecedent to the cold stage, may be recognized under the denomination of *access;* a term which has been employed to denote the cold stage, or the most intense degree of morbid action, and which, being already formed, cannot be regarded as the *access* of disease. Prior to the absolute seizure, however, there is commonly a more or less obvious failure of the living powers to perform any of their functions in their perfect manner; and that constitutes the true *access* of the complaint. The distinction and the term are practically useful as leading to sound pathological views, and to correct treatment.

The development, or attack of fever, is always sudden, whatever the duration of the predisposition; and this is one of distinguishing marks between fever and inflammation.

764, *b.* After the cold stage has continued for an indefinite time, the diseased conditions begin to assume a tendency toward their natural state, or to obey the great restorative law, the *vis medicatrix naturæ.* This recuperative effort introduces the *hot stage*, which is the first part of the natural cure. The prominent characteristics of this stage are an expansion of the capillaries, an increased volume of blood at the circumference, greater force of the general circulation, and an exaltation of temperature above its natural standard.

A spontaneous change has happened in the vital conditions of the whole body. The small vessels expand in consequence. Irritability has become more susceptible, but less profoundly altered, and the blood accumulated about the heart in the cold stage now rouses that organ to greater action, while it receives concurrent reflex nervous influences from the changes which are going forward in all parts of the capillary system. An increased volume of blood is thus sent out, and this is harmoniously met by the active expansion which is taking place in all the small vessels (§ 384–387). But this is only a part of the involutions of reflex nervous actions which are now in progress.

Notwithstanding, however, the hot stage is the beginning of the natural cure, the symptoms would often denote an increase of the morbid condition, and frequently call for the intervention of art. Nature may be excessive in her aims at reparation. She may overstep her ordinary limit, and push the organs of circulation with a ve-

hemence that shall light up inflammations, and call for an outlet of blood as an indispensable means of prevention (§ 674, *d*). But we know, from the general progress of symptoms, and the final result, that a succession of favorable changes has been instituted from the beginning of the hot stage.

764, *c*. The *crisis* follows next. This constitutes the greatest decline of the disease. The phenomena of health are now more or less pronounced. The secretions break forth, morbid at first, but rapidly assuming their natural character. Among these perspiration is the most obvious; and hence this stage of the disease is universally known as the *sweating*. The designation is too partial and hypothetical, since the volume of bile, or of urine, may be quite as redundant, or more so. *Crisis* is more comprehensive, and implies exactly the things which are in progress. The *hot* stage is better named; for exalted temperature is the beginning of the elaboration of redundant products, and, for a while, it stands alone. And here I may refer to this connected series of physical products, during the curative stage, as showing analogically the dependence of sweat, bile, urine, and the elevated temperature, upon common physiological principles, and in which alterative reflex nervous actions take an important part (§ 224, 226, 446–447, 461; 475–491, 503, 512, 902 *g*).

764, *d*. The secreted products, although the result of improving pathological changes, contribute, as in inflammations, to the ultimate design of nature as depletory remedies (§ 732, 733 *e*, 757 *a*).

764, *e*. In consequence of the foregoing remarks it may occur to some that there is a greater affinity between fever and inflammation than I have admitted (§ 712, &c.). But that conclusion does not follow from the course of nature in her restorative movements. The cold stage of fever may be the period of the most profound disease, and nature may be emerging toward her healthy standard during the stage of reaction, and yet the apparently analogous excitement of the general organs of circulation, and of the immediate instruments of the morbid process in inflammation, may be the stage of most profound disease; and this is known by the various attendant facts.* The pathological conditions, indeed, are so widely different, that the general arterial excitement attendant on inflammation is not, as in fever, followed by augmented perspiration, bile, &c. The increased products are relative to some particular part, and are not of the nature of those which attend the restorative process of fever. In one disease they proceed from a tissue, in the other from compound organs. One affection besets the tissues in their individual sense, the other in their compounded sense. These are, therefore, other broad fundamental distinctions between fever and inflammation (§ 141 *b*, 148, 675, 712–722, 757, 759, 764 *a*, 770).

765. If a repetition of the paroxysm take place, the crisis is always imperfect. Their repeated occurrence is said to form a *compound* fever; but, as we have seen, the disease is as much an entire whole as the ephemera (§ 759, 760).

When the paroxysms apparently go off entirely the fever is called an *intermittent*. When the interval is less perfect, or a new paroxysm takes place in the middle of a crisis, the disease is called a *remittent*. When the disease continues without much abatement of symptoms, or, rather, if a new paroxysm set in during the hot stage of a prece-

* Inflammation, as a general fact, is not introduced by a chill, but chills often precede suppuration, when disease is subsiding.

ding paroxysm, it receives the name of *continued* fever. Between the remittent and continued fevers, however, there is no well-defined line of distinction, as it respects the succession of paroxysms. Again, the remittent and intermittent interchange with each other; and it is even common for one attacked with a remittent to have the intermittent form before his recovery. When, also, intermittents are badly treated, they are often converted into a remittent; which is commonly a more intractable form (§ 557).

766. We have thus a series of analogies which connect the continued fever with the intermittent; and when we regard the distinct nature of the paroxysms of an intermittent, we see that the ephemera is a representation of each one. The symptoms also confirm these conclusions; from which we learn, more and more, that the essential elements are the same in all the preceding forms, and other minor varieties of the disease (§ 557, 650, 652, 670, 741 *b*, 754, 756 *b*). The existence of this coincidence corresponds with the like attribute of inflammations; the varieties of which, respectively, are not more remarkable in their vital manifestations and results than are the natural modifications of the vital properties in different tissues (§ 133–137).

767, *a*. Notwithstanding, however, the foregoing analogies (§ 765, 766), the causes of continued fever are so far different from those of the remittent and intermittent, that the first of these varieties does not interchange with the last, as do the last two with each other, although the quotidian and tertian types are sometimes manifested with considerable distinctness during the progress of continued fever. Remittents and intermittents are, also, rare in climates where the continued fever occurs, while the former go together, and have close affinities in their predisposing causes (§ 652, &c.).

767, *b*. We see, therefore, more and more, the fallacy of the doctrine which regards disease as a *unit*, and especially as propounded by one to whom medicine is under the deepest obligations. There are, indeed, no two cases precisely alike in their pathological conditions; and there is scarcely a principle of greater importance (§ 673, 857). It is true of diseases which are most allied, and even true of the same case during its advances or its decline; and coming to the specific forms of inflammation, and passing from those to idiopathic fever and the various modifications of this disease, and regarding in connection, also, the more obscure pathology of the various conditions of the stomach which are grouped under the general denomination of indigestion, and all those states which go to make up the "nervous disorders," we can scarcely fail of escaping from the illusions which have grown out of the physical views of disease, or of turning ourselves to that philosophy which concerns the mutability of the properties of life (§ 177–184, &c., 780).

768, *a*. In a vast proportion of all the cases of fever the paroxysms take place in the afternoon; generally beginning about five or six o'clock, and going off about five o'clock in the morning. This is common to all constitutions; nor is it much regulated by the force of morbid habit, but rather by its association with a natural evening paroxysm, to which all individuals in health are liable, and which happens and subsides about the foregoing hours, even when traveling to the eastward or westward (§ 772, *b*). This natural paroxysm is marked clearly by its phenomena; and the foregoing coincidence shows,

again, how the physiological laws hold their control in disease (§ 133–152, 638). A coincidence is farther seen in a diminution of the secretions attendant on the natural and morbid paroxysm. A purgative given now, whether in health or disease, irritates the system more than at any other time, and produces smaller evacuations than in the morning, especially if rapid in its operation. On the contrary, in either case, if the cathartic do not operate till morning, the discharge will be far more abundant. Toward morning the natural paroxysm subsides, sweating often comes on, and all the functions of the body and mind are then manifestly improved. And so, more or less, with the morbid paroxysm. The former is not connected with the fatigue of the day, since it is common to mankind under every condition of repose, employment, and habits.

Again, the first paroxysm of a fever may take place at any period of the day; the time of the invasion often depending upon some immediate exciting cause. But, the succeeding ones generally coincide with the natural evening paroxysm; especially in continued and remittent forms of fever. I speak, however, of the disease as manifested by unembarrassed Nature, or when she may be duly assisted by art. Misapplied remedies, and various other exciting causes, will be apt to affect the periodical law, especially where Nature is least recuperative, as in continued and remittent fevers. The regularity of the paroxysm is also influenced by local congestions and inflammations, and this, particularly, when exciting causes are in operation (§ 773). These considerations, independent of their practical bearing, refer to important problems in the philosophy of life and of disease.

The paroxysms of fever, therefore, observe a diurnal period; rarely taking place in the night.

768, *b*. The foregoing natural paroxysm extends its influences to all diseases, and influences, also, the operation of remedial agents.

769. If a paroxysm return two or three times, or two or three relapses take place at short intervals (as a few days, or perhaps weeks), the force of morbid habit is manifested; since in one case the paroxysms continue to return with greater obstinacy, and in the other relapses are more likely to follow, and this, often, for a great length of time (§ 535, &c., 768 *a*). Much, however, may be frequently due to supervening local congestions, which keep up the predisposition to fever, and operate, also, as exciting causes (§ 645, 665, 666, 870). Where the intervals are long, the return of the fever is not a relapse, but a new attack; though this is truer of continued than of intermittent or remittent fever. And this leads me to say, that any remote cause of fever is less apt to produce a relapse than to excite the disease in one who has not been before affected (§ 544, 550, 560, &c.).

770. It would be difficult to say why the paroxysms of fever are separated by definite intervals, and these intervals, too, remarkable for their variety as well as precision in the same form of fever. They show us at least, however, the absurdity of expounding disease by any of the laws or agencies that are known in the inorganic world. These definite intervals have given rise to several designations of the same form of fever; and according to the interval so is the *type*. We have nothing like this in inflammations (§ 712–722, 764 *e*).

771. In the continued form of fever, and in remittents, the paroxysms (or exacerbations, as they are then called) recur about once in

twenty-four hours; but the interval is more indefinite than with intermittents. In a majority of the cases of intermittent fever the paroxysms are repeated at the end of forty-eight hours, and hence the name of *tertian*, or tertian type. The next most common are *quotidians*, or fever with daily paroxysms; each one taking place at the end of twenty-four hours. A third, and most fixed variety, is called the *quartan*, having a return of its paroxysms in seventy-two hours.

772, *a*. Sometimes there is a periodical difference in all the varieties, or types, of the intermittent, of four hours; and if, as now and then happens, the difference be greater, the fever is said to be *irregular*. These irregularities are commonly owing to local congestions, or other accidental influences, the removal of which will generally establish the more definite interval.

772, *b*. When the foregoing deviations occur, the paroxysms may either anticipate the usual hour, or be delayed beyond it; and it is a remarkable fact, and strikingly illustrates the law of vital habit (since it is inobedient to the influence of the natural paroxysm of health), that in such cases the paroxysms are apt to go on with the particular irregularity with which they began (§ 544, &c., 768 *a*).

772, *c*. Another remarkable fact connected with the intrinsic nature of the vital properties, and illustrative of the special institutions of organic life, relates also to the inequality of the foregoing intervals. That is to say, if the interval of tertian paroxysms, for example, deviate from forty-eight to forty-six hours, or, on the other hand, from forty-eight to fifty hours, the occurrence of the paroxysms will be growing earlier in the former case, and later in the latter. But this is not the most striking phenomenon attending these cases; for when the paroxysms, by their regular anticipation of the period of each last preceding paroxysm, approach the night, one paroxysm is often lost. This phenomenon, however, has its more obvious foundation, as the others have more obscurely, in the natural law of the body already mentioned (§ 768, *a*), since there is no inherent tendency in the system to induce a paroxysm during the night (§ 137 *b*, 149–152, 638).

773. The intermittent and remittent fever are often so nearly allied in pathology, that it is sometimes difficult to decide upon the type. Here the deviation from the regular form of the intermittent is clearly owing to the presence of venous congestions, or to inflammation; since the intermissions will become well defined as soon as those complications are removed (§ 758, 762, 768 *a*).

774. The natural duration of continued fever is about three weeks, rarely six. It varies with intermittents according to the particular type. Such is the power of vital habit (§ 544, &c.), that a tertian naturally occupies from three to four months; and this is one of the numerous instances in which the advantages of medicine are illustrated, and the philosophy of solidism established; since, as it respects the pathology, an emetic, or a dose of quinine (of no analogous virtues), may so alter the morbid properties as to place them at once in a condition to recover their natural state (§ 557 *a*, 904 *d*).

Much, however, of the prolongation of fever is often due to the local forms of disease which supervene on its progress, to errors in diet, fatigue, &c.

775. Opposed, also, to the humoral pathology, and all the physical hypotheses, is the occasional sudden termination of continued and in-

termittent fevers, in a state of health. This is generally preceded by a severe paroxysm, and the disease is ended at once (§ 557, *a*). The very violence of morbid action is attended by an alteration of the organic properties which enables them to take on the recuperative process; just as we sometimes see alcoholic stimulants overthrow acute inflammation, or the same conditions of fever (§ 756). Will the chemist or humoralist explain? Fothergill, Falconer, and others, supposed that the full and tense pulse which often supervenes on apoplexy depends upon a struggle which arises from an action of the *vires vitæ* to restore health. "I believe," says Fothergill, "it happens in most cases where there has been a temporary, or even momentary cessation of the animal powers."

Remote Causes of Fever.

776. I come next to the remote causes of fever, and to consider, also, yet farther, how the general pathological condition, as in inflammation, is liable to modifications by differences in the nature of the remote causes, and how, also, fever is influenced by coexisting inflammations and venous congestions; with a view to farther illustration of principles of various import.

777. The predisposing causes of idiopathic fever probably consist, in all cases, of the results of vegetable decay (§ 652, 653). The special type and modification of the fever are determined very greatly by the nature of the new combinations; though other influences may contribute (§ 650, 651, 758, 762, 773). The essential causes make their impression so profoundly, that the incubation goes on although the causes may have long ceased to operate; which is commonly different with inflammations (§ 711, &c.). The causes of fever are also distinguished by the peculiarity of so modifying the organic properties of certain parts by their direct action, that the entire system is sympathetically brought into a corresponding morbid state (§ 148, 657 *b*).

778. The predisposing causes of fever have been considered in all their other relations to the disease under that general division of pathology; their modus operandi, the nature of predisposition, the intervening periods, &c. (§ 148, 644, &c.).

779. The predisposing causes of fever are also causes of inflammation and venous congestion; and hence it is, in part, that fever rarely continues long without the appearance of one, or the other, or both conjointly, of these local affections. Or, the local may precede the constitutional disease, and become its *exciting* cause; or the former may exist without developing an attack of the latter, although the system be predisposed to the constitutional affection. Or, again, the explosion of the general malady is very apt to occasion a full development of the local conditions of disease in organs so predisposed. But, independently of this predisposition to local disease, it is the great tendency of febrile action to lay its foundation. The occurrence of these local affections modifies very variously the constitutional disease, and increases its force and obstinacy. The treatment, therefore, must turn greatly upon the local complications, and remain strictly antiphlogistic till they are removed or greatly subdued.

780. It may seem remarkable that diseases which are so considerably diverse in their pathological conditions as fever and inflammation should be produced by the same predisposing causes. But this only

shows that there are analogies among all diseases. All depend upon certain states of the properties of life; and as these properties can never be greatly diverted from their natural conditions till life is at its ebb, there must be affinities among all morbid states. By considering, also, that the vital properties have various natural modifications in different parts we come to understand how the predisposing causes of fever may simultaneously predispose particular organs to inflammation, or venous congestions (§ 133–152, 741 *b*, 767 *a*, 786, &c.). What I have said, also, in former sections (§ 662, 670, 675) as to the fluctuating state of the vital properties and functions during the progress of a febrile paroxysm may reflect light upon this subject of analogies.

Pathological Cause of Fever.

781. Coming to the pathology of fever, morbid anatomy yields no assistance, and proves that our conclusions as to the essential nature of disease must be mainly derived from its phenomena during life (§ 695, &c.). It is therefore not remarkable that they who look for the philosophy of disease to its direct manifestations should alone distinguish idiopathic fever from inflammation (§ 695, &c., 712–722, 757, 759, 764, 770).

782. Next to the proximate cause of inflammation no question in medicine has occasioned more speculation than that of fever. The humoral pathology has been at the foundation of many hypotheses, and others have risen upon some supposed change in the organization of the solids. These were the ancient and are now the prevailing doctrines.

783. In no form of fever do the symptoms denote an absolute unvarying affection of any organ; but, on the contrary, the greatest variety occurs as to the force of the disease in different parts. These contingencies have suggested the minor designations as stated in section 758 (§ 134, 138, 142, 143, &c.).

784, *a*. Fever being a disease of the whole body, and constantly liable to complications with local inflammations and venous congestions, it is particularly important that all the attendant symptoms should become elements in forming our conclusions as to the nature and force of the disease, both in a general and local sense, and that our prescriptions should be determined by the aggregate weight of the phenomena (§ 675). Vicissitudes may be also hourly occurring in different parts, embarrassing to the judgment of the practitioner, and demanding its highest exercise (§ 675, 685, 686, 857).

784, *b*. Owing to the universality of the disease, and the general coincidence in its pathological character, remedial agents, when applied before morbid habit has taken possession, or local inflammations have supervened, will stretch their influence over the universal body, and may institute every where those pathological changes which are capable of a progressive march to their ultimate termination in health (§ 148–152, 487, 535, &c., 557, 672, 854, 893, &c.).

785. It is the triumph of morbid anatomy that it lays open to the senses the tangible products of inflammation; while it seizes upon what an observation of Nature had already determined as to the pathology of the disease. The great family of fevers shall sustain this position of the vitalist, since here nothing is seen, in numerous cases, after life has become extinct. The knife of the anatomist goes down

to the smallest fibre, and the aid of the eye-glass is summoned in vain. And yet do we know about as much of the pathology of fever, for practical purposes, as of inflammation, and the treatment of one is as well determined as of the other (§ 705). This has been inferred from the vital phenomena of both diseases, and from an observation of the effects of remedies. These phenomena are not less multifarious in fever than in inflammation; and so far as sensible changes attend the immediate instruments of disease there is more to be seen in febrile than in inflammatory diseases. In both there is commonly an increased volume of blood circulating in the capillaries; but there is also, as a common element of fever, a primary contraction of those vessels. What I have now said is the test between organic philosophy and morbid anatomy (§ 1056).

And how is it with the signs which denote the essential pathology? We have seen that the facts are equally clear in both diseases, that there is an exaltation of irritability and mobility from the time of their invasion (§ 743, 744, &c.). But that is all we can learn of the particular changes which they undergo in either affection, and that is only a minor part of the disease. The organic properties and functions have also sustained a change *in kind*, which is likewise known by the phenomena. It is that change which constitutes, essentially, the diseases, respectively, and which distinguishes one from the other (§ 177–181). The phenomena, however, do not indicate the nature of this essential change; but what they disclose as to the exaltation of irritability and mobility, in connection with their more indefinite suggestions, and with experimental observation, enables us to institute all the pathological and therapeutical principles that are necessary or useful in practice. The rest is concealed, because it would be useless for man to know it.*

The cold stage, or invasion of fever, when morbid action is most profound, is marked, it is true, by an apparent debility of the living powers; so much so, indeed, that it may be difficult to show that this universal opinion is erroneous. In a former section, however, I have attempted it (§ 743). Its practical importance cannot be too highly appreciated, since it deters the practitioner from the use of the lancet, or leads him to that of stimulants; especially in congestive fevers (§ 961, &c.). The error has proceeded, in part, from the very fact which evinces an exalted state of irritability and mobility,—the tonic contraction of the capillary vessels during the cold stage. The embarrassed action of the heart, diminished circulation, sympathetic influences of venous congestions, the partial loss of control over the voluntary muscles, or indisposition of the will to act, and the want of a proper estimate of the properties of life, and of the morbid changes to which they are liable, have contributed their share to this mistaken view of the pathology of fever. Nothing, however, has done so much toward the doctrine of "debility," and the stimulant treatment, as the impaired energy of the will over the voluntary muscles, which arises from the venous congestions that are associated with fever (§ 569, 487, 488½). I shall therefore proceed next to the subject of Congestion.

* I had a patient whose head of dense *black* hair changed in the course of one night to a bright *bluish turkey-green*, as the result of remittent fever. He recovered, and his hair returned gradually to its former black. I had been before skeptical as to the reputed effect of the nervous influence when excited by fear in changing the hair suddenly from dark to white.

VENOUS CONGESTION.

786. The pathology of venous congestion, its treatment, &c., form an extensive Essay in the Medical and Physiological Commentaries.

For all that relates to the pathology of that disease, as well as of varix, and for an exposure of the errors of former doctrines, and, indeed, for most that is essentially important in that Essay, I claim the merit of an exclusive originality (RIGHTS OF AUTHORS, p. 919, no. 28.)

787. The conclusions at which I have arrived, if founded in nature, are among the most important in practical and theoretical medicine; since the conditions which obtain in venous congestion often demand an energetic practice, reveal the true cause of the extensive mortality which has resulted from the stimulant treatment of fevers, and enforce the admission of some of the most important doctrines in physiology (§ 710, *b*). The relation, for example, of the pathology of venous congestion to the philosophy of the circulation of the blood, &c., illustrates the vital character, and establishes the elements of that complex function (§ 384–391).

788. During the last century, the enlarged state of the veins, which forms the prominent characteristic of venous congestion, attracted the attention of several writers, who ascribed a malign influence to the enlargement, though they regarded it merely as a mechanical phenomenon. From that time, till a recent period, this state of the veins was lost sight of entirely, notwithstanding it contributes, more than the recognized forms of inflammation, to the mortality of the human race. The neglect of this disease in our own times probably arises from the prevailing disposition to interpret organic phenomena, whether healthy or morbid, upon chemical and mechanical principles.

789. The foregoing enlargement of the veins is an essential condition of the disease, though of minor importance. This enlargement has been universally referred to an obstruction of the current of venous blood, or to a partial relaxation of the coats of the veins and a stagnation of blood within them. It has been also as universally supposed that all the evil results of this disease are owing to the accumulated or stagnated blood, while it is in the highest degree probable that neither the enlargement of the veins, nor the increased volume of blood within them, is productive of a single morbid phenomenon (§ 748).

790, *a*. The enlargements of veins which are produced by ligatures, hanging, reflux of blood, and as presented in the "circuitous circulation" occasioned by the pressure of tumors or obliteration of the trunk of a vein, are in no respect instances of venous congestion, although they are generally adduced as the most palpable examples of that disease. Nevertheless, the stimulus of distension arising from pressure on a vein may give rise to the sub-acute disease which constitutes essentially congestion, varix, and venous hypertrophy; as set forth in my former Essay.

Four mechanical hypotheses have been surmised, to meet the exigencies of all cases. One of them supposes, that, during the cold stage of fever, the blood being determined from the centre to the

circumference, accumulates about the heart, and then regurgitates throughout the venous system of the internal organs. A second is similar in principle. It supposes that, at other times, the accumulation results from a simply diminished energy of the *vis a tergo*, which is inadequate to the maintenance of a free circulation, and that an accumulation of blood takes place in the veins as a consequence. A third hypothesis assumes that an embarrassed circulation takes place in the lungs, by which an obstruction is constituted to a return of blood to the heart, when, also, as a farther consequence, the blood accumulates in the veins of other parts, particularly the head. The fourth hypothesis has a similar mechanical cause. It imagines that venous congestions in all parts are owing to obstructions occasioned by hepatic disease.

I have shown that the objections to all the foregoing suppositions are numerous and conclusive. In respect to those of a general nature, which are mostly applicable, I may now say that it is obvious that the blood would accumulate principally about the right cavities of the heart alone, and not in the veins of distant organs. Or, should a reflux happen, it should be coextensive and equal in the veins of all parts at equal distances from the heart. On the contrary, however, venous congestion is limited to particular parts, often to one organ, which may be, also, distant from the heart or supposed centre of obstruction. It is often, for example, the brain only that is congested; where, too, accumulations of blood, unless from disease of the venous parietes, would be prevented by gravitation alone. Again, also, were there any foundation for these hypotheses, the liver, stomach, kidneys, lungs, &c., should always be congested whenever the brain is the seat of the supposed reflux of blood. It is also obvious that, the moment an equilibrium is restored to the general circulation, as in bloodletting, the volume of blood should be equally reduced in the veins of all parts. Contrary to this, however, the veins of some particular organ or organs often continue in a state of great enlargement, as in the brain, &c.; while the central accumulation of blood, the supposed cause, is now completely removed.

790, *b*. So indefinite has been the pathology of venous congestion, that injuries attendant on falls, and those prostrated states that are induced by the shock of surgical operations, have been regarded as identical with profound congestion; and this even by so distinguished and able an observer as Dr. Armstrong. This great error in theory may explain his commendation of stimulants in aggravated forms of congestive fever, and is probably one of the causes which have led to their more indiscriminate use in less prostrating conditions of the disease (§ 970).

791. To arrive at the true pathology of venous congestion, as well as to ascertain the powers which circulate the blood, it was one of my primary objects to show that the state of the circulation in congested veins is exactly the reverse of the foregoing supposition (§ 790); that is to say, that the veins are in a state of active dilatation, and that the blood circulates freely within them. (See *Comm.*, vol. ii. Also, § 382–394.)

792. I have shown, also, that the veins are susceptible of active dilatation in their natural state from the local irritation of stimulants; and that it is owing, primarily, to this action of the veins that they

swell when the hand is immersed in warm water or exposed to a fire From these premises, I passed on to a demonstration that the veins possess an exquisite relation to the communicating arteries, of a sympathetic nature, and by which they dilate actively in obedience to the action which exists in the communicating arteries, and the quantities of blood which may be transmitted.—See, also, § 387.

I endeavored to show, also, that when the veins become inflamed, as in acute phlebitis, or in the sub-acute state of venous congestion, the inflammation of their coats acts as a stimulant, and thus occasions an active dilatation.

793. Whatever, therefore, will produce any degree of inflammation in the venous parietes, will be a remote cause of dilatation; and, although the phenomenon depend upon that physiological constitution of the veins which occasions their active dilatation when increased quantities of blood are transmitted from the arteries, or when they are irritated by simple stimuli (§ 387), there is a wide difference in the proximate cause of the morbid and the natural phenomenon. In the latter case there is simply an obedience to natural influences, and the phenomenon is therefore transient; in the former, the influences are morbid, and the organic properties altered from their healthy standard, and the dilatation, therefore, is also cotemporaneous with the disease, or until the vein becomes disorganized, as in acute phlebitis. In the natural state there is also an increased volume of blood constantly transmitted to the veins; in the morbid the increased volume depends upon the enlargement of the veins. And yet the morbid dilatation has the physiological constitution for its foundation.

The following example shows the operation of the natural principle. "Cooks," says Sir B. Brodie, "are subject to varicose veins. Why? If you put one hand into warm water, and the other into cold, you know that the veins of the former become dilated, and that those of the latter will contract."

This is a clear illustration of the physiological constitution of the veins, both as to active dilatation and contraction. But it goes no farther. The dilatation is the result of the operation of a healthy vital stimulus, and depends, in part, upon a constantly-increased volume of blood which is transmitted from the arteries, as set forth in section 387. In varix there is no such increased volume transmitted, nor in phlebitis, nor in venous congestion. The dilatation is also permanent in the latter cases, while in that of the cook it subsides as soon as the stimulus of heat is withdrawn. The illustration is, indeed, a contradiction of the intended philosophy, since cooks are not subject to varicose affections in their arms, which are alone, though constantly, exposed to hot water. And so of the glass-blower. It is nothing more than the phenomenon which proceeds from exercise, or febrile action, or even from the common forms of inflammation; though slightly modified in these morbid states of action. The example serves to confirm, also, what I have taught as to the physiological relations between the arteries and veins, and the instrumentality of a great principle in the circulation of the blood (§ 387).

The assumed analogy to varix in the foregoing example is a part of the common mistake of confounding the physical with the vital laws, and shows the untenable nature of all such positions. We relax dry, dead matter by soaking it in warm water. The water pen-

etrates the substance; and this whether warm or cold. But what would be the effect upon the cook if she take the hand from the warm water and place it with the other in the cold water?

794. The venous tissue is composed of three coats; the inner, which resembles considerably a serous membrane, the middle, which possesses longitudinal fibres, and the external or cellular coat.

The inflammation is seated mostly in the inner coat. Contraction and dilatation are effected by the fibres of the middle coat; which, being longitudinal, are capable of producing contraction or dilatation with rapidity and uniformity over a great extent. This natural provision was necessary to the purposes of venous circulation, and to accommodate the diameters or capacity of the veins to the suddenly and constantly varying proportions of blood transmitted to them from the arteries. Circulation could not be performed without it; since, if the dilatation of the veins were effected by the supposed mechanical distension of the blood when increased volumes are determined upon them by the arteries, the physical resistance of the veins would impede the transmission, and the subsequent progress of the blood. There would then be a want of harmony between the arteries and veins, which would constitute a fundamental defect in organization. Nay, more; this harmony reaches, also, to special modifications of the organic properties of the venous tissue, by which the veins are rendered sensitive to the varying states of the capillary arteries, and to impressions arising from the varying quantities of transmitted blood (§ 133, &c., 385).

795, *a*. Now, it is in the foregoing peculiar organization of the veins, and the special modifications of their vital properties, that all the remarkable phenomena of acute phlebitis and venous congestion have their foundation. The veins dilate actively when inflamed, because such is their natural function when impressed by stimuli, especially their natural stimulus, the blood. Their dilatation is permanent in inflammation, as that affection operates as a permanent stimulus; and irritability is permanently increased, by which the blood has, also, a preternatural effect (§ 143, &c.).

795, *b*. From the exquisite development of their organic properties, the veins are extremely liable to inflammation; especially that subacute form which constitutes venous congestion. And whether their inflammations exist in the form of acute phlebitis, varix, or venous congestion, it is always diffuse, extending rapidly over the venous tissue, and liable, in all its forms, especially of phlebitis and congestion, to give rise to great constitutional disturbances. The diffuse nature of inflammation is partly owing to the natural principle by which the venous tissue has an associated action over an extensive surface; and all the local and constitutional phenomena may be traced to the peculiar vital constitution of the veins (§ 151, &c.).

Turning, however, to the arterial system, we find all things quite the reverse, and referable to the natural vital constitution of those vessels (§ 149, &c.). The arterial tissue is very little liable to inflammation, the disease is always very circumscribed, and produces but little, or no constitutional effect (§ 140, 526 *a*).

796. It was an important object in my Essay on Venous Congestion to establish satisfactory analogies between acute phlebitis and venous congestion, and I extended the analogies to varix and venous

hypertrophy; and in so doing, as well as by the specific facts, demonstrated the inflammatory nature of these last affections. The several conditions were thus brought to illustrate and confirm the common nature of their pathological cause. Nor was the necessity overlooked of showing the fallacy of the universal doctrine of the dependence of varix upon local obstructions to the venous circulation and stagnation of blood, nor of applying to practical uses the true pathology of varix (§ 350¼). It was thus shown how it happens that tying, or dividing. varicose veins, is so often followed by active phlebitis.

Besides its never having been shown that any obstructing cause exists either in venous congestion, or in the early stages of varix, if any stagnation of blood arose from other causes, the valves of the veins should be closed, and a knotted appearance presented at the several points. Such, indeed, had always been the supposition in relation to the valves, till I proved it otherwise. While the blood circulates, the valves are necessarily open (§ 391).—RIGHTS OF AUTHORS, p. 919.

797. Taking the most simple and subdued form of venous inflammation, and in its most local sense, we have a type of the whole by which we may ascend progressively upward till we reach the strongly-marked conditions of phlebitis, without losing a hold upon many striking analogies which assure us that the common feature is imparted by venous inflammation. When constitutional influences may not obtain, as in the ordinary conditions of varix, there are still present the dilatation of the veins, their long-continued, unembarrassed circulation, their ultimate disorganization, pain, soreness, liability to active phlebitis, &c., to establish the intimate relationship of varix to the highest grades of venous inflammation, and to throw a broad light over the common family, however they may be removed in degrees of consanguinity.

798. It is also an important practical fact, as well as proof of the physiological doctrine of venous congestion, that this affection often springs up in quick succession in different organs, and often manifestly as sympathetic results of each other (§ 525, *a*). The same is also partially true of active phlebitis. Apoplexies are often remotely owing either to irritation of the stomach, or to venous congestions of the liver. On dissection, we find in most of the cases a state of venous engorgement in the brain, which has been excited sympathetically by one of the foregoing causes. It is especially to hepatic congestion, connected with peculiar influences of external predisposing causes, and the law of sympathy which predominates in the venous tissue (§ 387), that we must ascribe the epidemic apoplexies which have been described by numerous writers from Hippocrates to our own times. And how absurd would be the conjecture that in such apoplexies there happens an epidemic mechanical obstruction to the venous circulation of the brain, and where, too, gravitation would prevent all accumulations of venous blood, were it not for the active, morbid dilatation of the veins!

799. My demonstration, also, of the essential contribution of the derivative or suction power of the heart to venous circulation brings into view another principle which must tend powerfully to prevent all accumulations of blood in the veins.—(*Essay in Comm.* Also, § 388-390.)

800. Passing over a multitude of facts which I formerly embra

ced in the foregoing illustrative proof of the inflammatory nature of venous congestion, and varix, I may now appeal to morbid anatomy for a tangible demonstration of my conclusions. But this ground is too extensive and circumstantial for the objects of the present work; and it has been most amply explored in my former Essay. It is worthy of remark, however, that the blood often gravitates from congested veins of the liver after death (p. 725, *note*).

801, *a*. Let us, therefore, attend next to a more practical demonstration, which will be again resumed under the Philosophy of the operation of loss of blood; namely, the appropriate treatment of venous congestion, in its simple forms, and as complicated with idiopathic fever. There is no practical question of greater moment, none more likely to be decided by theoretical principles, and none where the therapeutical facts settle more conclusively the nature of the disease, and the principles which should guide the treatment.

801, *b*. The method of cure had been either empyrical, or without a sound principle to guide it, till my Essay was published. So far as the mechanical hypothesis has had its sway, it has led to nothing but error, suffering, and death; since, upon that ground, stimulants have been the remedies.—NOTES F p. 1114, S p. 1124.

Nevertheless, experience has led some of the soundest minds, as it has many in regard to the humoral pathology in its broad application, to disregard the dictates of hypothesis, and to depend upon bloodletting and other antiphlogistic means; and the result has proved that they are the only successful means. But there was little of this practice till the time of Armstrong, and even this philosopher yielded to the mechanical doctrine in those intense forms of the disease where loss of blood was most imperatively demanded (§ 4, 960, 961, 964 1005). Bloodletting was inculcated by the ancient masters.

Now, therefore, antiphlogistic means being the remedies for inflammation of other tissues, and stimulants, as in such inflammations, being pernicious in venous congestions, they concur with all other facts in establishing the inflammatory nature of this disease.

801, *c*. By the guide of the pathology and principles which I have indicated, and as shown by the results of the best and the worst experience, we apply ourselves to the work of cure with an intelligible object before us; nor are we harassed by doubts, nor fluctuate from experiment to experiment (§ 960, 1005). There is a specific object in contemplation, the only principal one to which our treatment should ever refer (§ 667, &c.), and we pursue it with steadiness of purpose, and without the alarm or those imputations of imbecility to a noble art which flow from the mechanical doctrine, with its associated visions of *debility*. We regard the sluggish mood of the will as constituting much of what otherwise seems a state of universal weakness (§ 487 *h*, 569, 743), and look, as in all other cases, with the calmness of an enlightened understanding, upon an insidious and powerful foe, since we know his ambush and his strength, and our own means of circumvention and defeat.

802. As to the incipient seat of venous congestion, I shall only now say, that farther observation has sustained the opinion which I expressed, and endeavored to enforce, in the *Commentaries*, that there is "much ground for believing that the inflammatory action begins in the capillary veins, and that it is subsequently propagated to their trunks."

Many grounds are set forth for the conclusion, some of which were of the nature of principles; such as the extent in which the venous system of organs is generally and simultaneously involved, &c. This also corresponds with what I have said of the natural function of these vessels in relation to the varying proportion of transmitted blood.

When the larger veins are the seat alone of accumulated blood, they are commonly isolated, as in varix. Nor does venous congestion affect the largest series; but it is commonly limited to some complex vital organ, where we are certain that the capillary veins are more highly endowed with the properties of life than in parts which are less instrumental in the great organic processes, and where remote causes, external and internal, may therefore operate with greater intensity, or any general derangement of the organ may develop in the venous capillaries the supposed morbid condition. The terminating series of the arterial system are the instruments of all the great vital actions, and of all diseases,—of venous congestion itself. Analogy, therefore, as well as the general office of the veins, and their anatomical and functional alliance to the terminating series of arterial vessels, show us that the organic properties of veins are more strongly pronounced in the venous capillaries than in the venous trunks. And yet they may be so modified that inflammation may run higher in the trunks than in the capillaries (§ 134, 387, 526 *a*).

803. Venous congestion often passes rapidly into inflammation of other tissues with which the congested veins may be associated; and both forms of the disease frequently exist together in the same organ. This remarkable fact of the ready passage of venous congestion into inflammation of other associate tissues grows out of the vital relations between the veins and arteries (§ 387). The mode of propagation, therefore, is by continuous sympathy* or by reflex nervous action. The presence of inflammation in the coats of the veins operates either directly or indirectly as a stimulus upon the communicating arteries, through the foregoing natural relations (§ 802), and thus becomes a sympathetic cause of inflammation in some other associate tissue. The nature of the irritation is strongly manifested in the violent pulsations of the abdominal aorta, and of the cœliac and carotid arteries, in hepatic and cerebral congestion; and, I may add, that this phenomenon alone would establish the vital nature of the whole assemblage of movements and results. It is the result of continuous sympathy.*

804. But, while the foregoing morbid action is taking place in tissues associated with the congested veins, an abatement of the congestion or venous inflammation is simultaneously going forward. This harmonious process involves, also, another beautiful exemplification of reflex nervous action. As soon as the supposed influence is established upon the capillary arteries of the surrounding tissues, a reaction of sympathy takes place in the veins, by which the morbid state is overcome (§ 143 *c*, 152, 524 *c*, 528, 657, 660, 905). Their contraction then follows, as a consequence, and "the balance of the circulation," as it is called by the mechanical theorists, is more or less restored. This salutary reacting sympathy which arises from the supervening diseases is a common phenomenon. Pulmonary affections, for example, will supervene by reflex action upon gastric disease, and simultaneously operate as a relief to the stomach. A part of this great and universal law is manifested by the operation of blisters, and sometimes,

* *Continuous influence* of these Institutes (§ 129 *c*, *f*, 498 *a*).

when the artificial disease subsides, its abatement accelerates the decline of the natural affection, and thus exemplifies the law of reflex nervous influence in its compound aspect (§ 733 *e*, 893, 905).

Inflammation of other tissues is also an exciting cause of venous congestion, and here, too, the primary affection is apt to subside when the sympathetic one has taken place; the philosophy being the same as in the preceding case (§ 638½).

Again, active phlebitis of the liver is not infrequent, preceded by symptoms of venous congestion, which has simply passed into the more active state, just as irritation of varicose veins will excite acute phlebitis.

805. With the farther object of illustrating the pathology of venous congestion, as, also, to ascertain the pathology of spontaneous hemorrhage, I have gone into a critical inquiry relative to the latter subject in two Essays embraced in the *Commentaries*, one of which is devoted to that investigation (vol. i., p. 371–384; vol. ii., p. 546–566). The subject involves some physiological and therapeutical principles of great moment; and so far as I have shown the general dependence of hemorrhage upon venous congestion, it goes with my other facts in establishing the inflammatory nature of the disease. As a preliminary step, I demonstrated by the observations of mechanical theorists, that the prevailing physical *rationale* is contradicted by their own facts; that it is very rare that ruptured vessels have been detected by the microscope, and that no vessels admit the transudation of their fluids till putrefaction has opened the way. I shall now only add, that I have variously shown that capillary hemorrhage is not only the result of a vital process, but is analogous, as had been supposed by Hunter, to that of secretion. Prominent examples occur in purpura hemorrhagica, in petechial fevers, in sanguineous apoplexy, hæmoptysis, &c. (§ 1002).—Note Bbb p. 1148.

The effusion of blood is the result of a salutary effort of nature to relieve the venous inflammation (§ 732). The quantities of blood which are often poured out in this condition of disease, not only with safety but with relief, are perfectly astonishing, and such as would be fatal if imitated by art. We may, however, well take a lesson from nature as to this her antiphlogistic treatment of venous congestions, and pause over the administration of stimulants to revive the energies of powers when prostrated by an overwhelming load of venous inflammation, for the relief of which nature often snatches the cure from the hand of art, and astonishes the stimulant practitioner by a stupendous and successful discharge of blood (§ 812, 1018, 1019).*

806. The influences of venous inflammation, in all its degrees, are very different from inflammation of other tissues (§ 140). The general circulation, for instance, is apt to be much excited in common inflammations; but in acute phlebitis, and in venous congestion, the influences are quite liable to be of a depressing nature, especially upon the general circulation. This is generally true when either form of the disease exists in its greatest intensity; and the phenomena of excitement obtain, more or less, when these forms of venous inflammation are less violent, or when on the decline.

Its morbific reflected nervous influences, whether it be acute or subacute, are of a compound nature; partly the exciting influences of inflammation when affecting other tissues, and partly the depressing effects which are peculiar to morbid changes in the venous tissue.

* See Notes F p. 1114, Ff p. 1135, Gg p. 1138, Ii p. 1139.

These are the most visible results, though more profound changes take place. The predominance of these two manifest influences is generally on the side of the depressing effect, in the stages of full development; but, in what may be called the chronic state of venous congestion, the exciting and depressing tendencies seem more nearly balanced. An exception, however, should be made in respect to venous congestion of the brain, where the usual exciting influences of inflammation are commonly in the ascendant (§ 686 *b*, 974 *c*, 975). It frequently happens that a very decided hardness, incompressibility, and considerable fullness of pulse attend the chronic forms of hepatic congestion, and that there will be little other apparent constitutional disturbance, excepting as the stomach performs its office imperfectly, the bowels more or less torpid, &c., and that these cases may suddenly eventuate in a very aggravated form; especially if miasmatic fever happen to supervene. The character of the pulse then undergoes a very striking change; becomes small, accelerated, loses much of its hardness and incompressibility (§ 686 *b*, 688 *d*, *e*). A chronic state of hepatic congestion is often the forerunner of miasmatic fever, and one of its exciting causes; the local predisposition having been formed by the predisposing cause of the general malady (§ 665, 813).

807. The local phenomena, also, are apt to be obscure in all gradations of venous inflammation; and it is no unusual event for uterine phlebitis to terminate fatally without its presence having been suspected; till a post-mortem examination has revealed a disorganized state of the uterine and iliac veins, attended with purulent matter within the vessels. And, although it is not my purpose to enter into a detail of symptoms beyond what may be necessary to illustrate the pathology of venous congestion, and the general principles which I have in view (§ 800, *b*), it is still worthy of the practical remark, and as showing, also, the special constitution of the venous tissue, that its inflammations of every degree are apt to be unattended with much pain, or tenderness on pressure; excepting when in the form of varix, which is sometimes very painful, and often tender (§ 725, *b*). An absence of those common phenomena of inflammation of other tissues, and perhaps only a subdued state of some other of its striking symptoms, not unfrequently betray the unwary into a false security, or beguile him into the fatal belief that "debility" is the worst attendant.

808. Upon my theory, therefore, of the pathology of venous congestion, we see more and more an admirable concurrence between the morbid phenomena of that affection and the natural physiological manifestations of the venous system; and we arrive through the physiological data at a ready interpretation of the most difficult problems in venous congestion. By these data we are enabled to discover, also, why the veins of the external parts of the body are not, like those of the internal organs, subject to congestion, but rather to varix; and why, again, an acute inflammation of a large internal vein is often limited to a point of divergence (§ 133–152, 526, 576 *d*, 578 *d*, 579 *b*, 721, 722, 794, 795).

809. It is owing especially to the foregoing peculiarities of venous inflammation, that when complicated, either in its form of acute phlebitis or venous congestion, with idiopathic fever, it greatly modifies the phenomena of that disease; rendering it insidious, obstinate, and fatal (§ 651, 652, 722 *c*). It is always an attendant of the plague

yellow fever, typhus, cholera asphyxia, "black death," &c., and imparts to them much of their peculiarities, severity, and danger.

810. Venous congestion and acute phlebitis not only steal their march in ambush (§ 807), but often throw a mask over constitutional fever, or present their own characteristics as the prominent phenomena. Hence it is that when venous inflammation is artificially excited by mechanical injuries of the veins, or by irritating injections, the results are said to resemble those of typhus, or yellow fever. It was this illusion, as well as a radical defect in his physiological views, and practical observations, which betrayed Magendie into the experimental fallacies recorded in a foregoing section (§ 744).—NOTE S p. 1124.

It will be also observed that the experiments go to prove the dependence of many of the phenomena of typhus and yellow fever upon the attending venous congestions.

811. The foregoing modifying influence of venous congestion upon idiopathic fever (§ 688 *dd*, 806, 810, 961, &c.) is one of the many clear demonstrations of the modifying effects of local disease upon the vital states of the whole system, illustrative of the manner in which it may bring all parts into harmonious relation with any changes which such local disease may effect in the blood, and which would otherwise prove morbific (§ 847, *g*). It shows, also, how the entire body may be rendered susceptible, through morbific influences, to the action of remedial agents which might be otherwise inert, and how, when those agents exert salutary effects upon the various parts that may be partially influenced by some local malady, the morbidly sympathizing parts may then become reacting sources of salutary impressions upon the more absolute seat of disease (§ 143, 149–152, 514 *h*, 638, 804. Also, *Med. and Phys. Comm.*, vol. i., p. 649, 653–655, &c.).

The reflex nervous influences of venous inflammation being of a mixed character (§ 806), are extended, also, over the phenomena of any coexisting membranous inflammation, as well as of idiopathic fever; thus presenting still farther, in their delicate shades as well as prominent characteristics, the complex results of different forms of disease, whether existing independently or in connection with each other, or offering a striking illustration of the natural modification of the properties of life in the different tissues and organs, of the manner in which morbid changes in any common disease correspond in peculiarities with the natural peculiarities of the vital properties of the tissue, and showing how reflex nervous influences exerted on remote parts correspond with the peculiar conditions now stated (§ 133–151, 191, 577, 578). It is also worthy of remark, that where venous congestion is complicated with inflammation of other tissues, it is apt to lessen the hardness and force of the pulse, and to modify the other symptoms which are usually attendant on the recognized form of inflammation. In congestive pneumonia, and epidemic erysipelas, for example, it so far disguises the usual phenomena of the associated inflammation, that practitioners are constantly betrayed into the fatal use of tonics and stimulants. These associated conditions supply, also, a good exemplification of the tendency of venous inflammation to maintain the pulse within a limited degree of that hardness and incompressibility which are often very strongly pronounced in inflammations of other tissues (§ 638½, 814, 1005 *h*).

812. Examples of independent, isolated forms of venous conges-

tion are constantly seen in the brain, especially of children and apoplectic subjects, in the liver, &c. (§ 790, *a*). But the most prominent instance occurs in purpura hemorrhagica, where all its phenomena may be studied, and where its inflammatory nature may be fully ascertained, particularly if not complicated with fever, or with inflammation of other tissues, but depending, immediately, upon extensive congestion of the veins (805, 1002 *d*).

813, *a*. Venous inflammation in the form of congestion is occasioned more frequently than inflammation of other tissues by the predisposing causes of idiopathic fever (§ 644, &c., 742, &c., 776, &c.). Congestive fevers and local congestions prevail, therefore, at the same time and places. Both may also prove exciting causes of each other (§ 712, 777, &c.). The local affection may exist many weeks, grow into a state of intensity without being suspected (§ 807), and finally give rise to an explosion of fever, which, from the mildness of the predisposition, may not have happened but for the exciting influences of the local disease. The fever which ensues, though not a sympathetic, but an independent disease, aggravates the local congestion, and gives greater intensity to its symptoms; though both conditions may coexist for some time in great force and obstinacy without any prominent or alarming symptom. These cases are not uncommon, nor is it a rare circumstance, in such instances, for practitioners in good repute to stand appalled over a lifeless body where they had only a few hours before predicted an early convalescence; and if the morbid anatomist be summoned to the scene of disappointment, chagrin, and distress, he seeks in vain for his *post-mortem pathology*, and pronounces a malediction upon Nature, or upon the imperfections of science, or upon the imbecilities of art (§ 695, &c.). "Medical philosophy is a metaphysical subtlety, and it were a thousand times better to confess our ignorance than to give up our senses."

813, *b*. Since, therefore, miasmata are so extensively the cause of venous congestion, it is important to consider that its exact pathological character will depend, cæteris paribus, like that of fever, upon the exact nature of the miasma (§ 653). Hence, also, the constitutional modifications of fever by venous congestions will be more or less determined by the exact pathology of the venous disease, as well as by the general effect upon the system of the miasmatic agent (§ 644, &c., 722 *c*).

814. The considerations which have been now made enable us to understand the sources of those numerous modifications which distinguish the different species of fever, and aid, especially, our comprehension of their connections with venous congestion, and the various modifying influences of this disease upon the constitutional affection. Depending greatly on the specific nature of their predisposing causes, the local, as well as the constitutional changes, being imbued in the several cases with the specific influence of these causes, and the general characteristics being determined, for the most part, by the constitutional affection, the incidental venous congestions impart yet another general resemblance among the congestive fevers; varying the whole from their simple type, and often more or less confounding the specific phenomena under a common aspect (§ 638½, 811).

It is upon principles which I have now, and at other times stated, that we may understand why the typhus of one country, or of one

season, has been, under equal circumstances of treatment, varied in its phenomena from that of another; why epidemic scarlatina and measles are more fatal than the simply contagious; epidemic erysipelas more so than sporadic; why the intermittents of Africa are more pernicious than those of other countries (§ 630 *e*).—NOTE Oo.

815. When venous congestion so far disguises the attributes of idiopathic fever as to present the constitutional phenomena of venous inflammation, there is no condition of disease which demands more imperatively enlarged views in pathology, a deeper scrutiny of symptoms, or greater moral firmness for its appropriate treatment. If danger be seen, it appals the timid, and prostrated voluntary power urges him to the fatal use of stimulants (§ 487, 488½, 569). Under these fearful, but common conditions, the presence of well-marked inflammation of other tissues contributes to the safety of the patient. Such inflammations, however undesirable in other aspects, tend to counteract, for awhile, the depressing influence of venous inflammation, to lull the imagination, which sees nothing but "debility," or "putrefaction," in the prostrated state of the circulation and of voluntary motion, and in itself sustains the powers of life under the influence of depletive remedies, which alone can cure; and gives the last remaining hope which may be inspired by the unaided *vis medicatrix*, but which may be speedily extinguished by tonics and stimulants (§ 662 *b*, 675, 686).*

816, *a*. Venous congestion, being mostly occasioned by miasmata, prevails in its local form simultaneously with congestive fevers, and independently of any apparent predisposition to the latter. In this simple condition the disease is most apt to affect the abdominal organs. Nevertheless, it is evident in many of these cases, that the system is also imbued with a predisposition to fever (§ 666). In a still more simple form it is common in cities; particularly south of the latitude of forty degrees. It seems then dependent, also, upon malarious causes. And when it is considered that the liver is especially the seat of venous congestion in the different forms of congestive fever, and that the veins of this organ are quite liable to acute phlebitis, and that the phenomena of each are often analogous, a very special proof is thus supplied of the correspondence of the pathological states (§ 390 *b*, 526 *b*, 803, 809).

816, *b*. Other causes of malign influence may be transiently noticed. The disease, for example, is generally an accompaniment of severe forms of scarlet fever, appearing then mostly in the liver and intestinal canal; when it is also badly modified by the predisposing cause of the more specific affection. Again, it often springs up as a sequel of scarlet fever; when it is also imbued with the lingering influences of that complaint, and presents obstinate and difficult problems for the practitioner. It is still the digestive organs that suffer its invasion; and now it not unfrequently leads to inflammatory affections of the peritoneum, or of the cellular tissue of the surface, which ends in dropsical effusions; or, as when coexisting with scarlatina, glandular swellings may suddenly supervene about the neck. This is especially true if the intestinal canal be often subjected to the irritation of mercurials, which are apt to be of a peculiarly morbific nature in scarlatina (§ 689, *l*). Gastric irritations in childhood are common causes of hepatic and cerebral congestions; and in many adults there is a constitutional predisposition to cerebral congestion which is

* See NOTE S p. 1124.

apt to terminate in sanguineous apoplexy. Various kinds of poisons, animal and vegetable, healthy and morbid, give rise to venous congestions; each one imparting some peculiar shade of difference to the affection (§ 721, 722). Such is the case with the narcotic poisons, alcohol (in delirium tremens), hydrocyanic acid, the poison of dissection wounds, the wourari, &c. (§ 662, *c*).

All the foregoing causes, excepting miasmata, produce the local forms of venous congestion; which is therefore never complicated with idiopathic fever when proceeding from those causes (§ 653).

817. Looking back upon the attributes, the causes, the constitutional effects, and the morbid anatomy, of venous congestion, and considering what is yet to be said of its treatment (§ 961, &c.), we find a great amount of proof in favor of the vital doctrine which I have propounded as to the pathology of this disease. As in inflammations of other tissues, the causes are such as make their impressions upon the properties of life. We see, also, in like manner, even a greater variety of modifications of the phenomena, corresponding, also, with the special nature of the predisposing causes. We see the disease influenced by peculiarities of climate, habits, constitution, age, &c., and constantly arising with or without fever in some places, while it is rare in others. It affects the robust far more frequently than the weak; high livers, the sanguine, and especially tipplers, more than the temperate and other constitutions. We see it slaying the morbid anatomist, while its remote cause has been concealed in a wound which no microscope can discover. We see it springing up in the brain in obedience to the specific relations of many agents to that organ; narcotic poisons, alcohol, prussic acid, carbonic acid gas, &c. We see it coexisting with affections of a distinctly inflammatory character, as measles, small-pox, scarlatina, &c., always increasing their violence, and adding, according to the nature of the principal disease, to their fatality, as when complicated with idiopathic fever. Or, if it supervene on common derangements of other parts, those maladies are such as predispose to inflammation of other tissues. Nor has morbid anatomy detected a cause of obstruction, nor can reason surmise a cause for a single instance in the midst of the variety; but where, on the contrary, the variety alone of predisposing causes demolishes the whole fabric of the mechanical pathologists.

If we turn to active phlebitis, or admitted inflammation of the veins, we find it equally depending upon the predisposing causes of venous congestion, and both diseases often associated in the same organ, or presenting themselves together as complications of idiopathic fever, and often making demonstrations of the same phenomena. Shall we, therefore, in one case, impute the phenomena to a simple mechanical fullness of a limited portion of the veins, while in the other, we refer the analogous symptoms, and the venous enlargement, to a local disease whose pathology is settled upon the broad basis of organic action?

The treatment is yet in reserve as contributing largely to the comprehensive philosophy of bloodletting, and as demanding, more than any other disease, that summary remedy. Let us, therefore, study the pathology of venous congestion, as of inflammation, through the philosophy of the operation of loss of blood, and the analogies which are supplied by its effects upon all other inflammatory conditions;

nor, when deliberating upon these profound and important topics, let us neglect the coincidences in the adverse effects of tonics and stimulants.

818. I now dismiss the great subject of venous congestion; than which none greater can undergo the attention of the philanthropist or the medical philosopher. But he may not bring to its investigation any fancied analogies, nor any of the laws, or other conditions of the inorganic world. He must start with all the philosophy of organic life, carry it all into the depths of the subject, and finally try the grand result by the test of therapeutical principles. He will then have found that he has accomplished a study of the most elaborate character, and where medical philosophy is presented in its most difficult but elevated aspects. He will have cleared up the way to all other obscurities in medicine, and have obtained a key by which he will acquire a ready access to most of the arcana of organic beings.

REVIEW OF THE PHILOSOPHY INVOLVED IN THE FOREGOING DISCUSSION OF THE REMOTE AND PATHOLOGICAL CAUSES OF DISEASE, AND OF THE SPECIAL CONDITIONS KNOWN AS INFLAMMATION, FEVER, AND VENOUS CONGESTION, AS IT RESPECTS THE NERVOUS SYSTEM.

818½. Throughout the foregoing field I have endeavored to expound the operation of the remote causes of disease, whether of an external or internal nature, and of all remedial agents, which, in either case, exert their effects upon parts remote from the seat of their direct action, through *the natural laws of reflex actions of the nervous system*, and have endeavored to demonstrate variously modifying influences of those causes, and according to their special characteristics, upon the nervous power which is thus brought into a preternatural and alterative condition (§ 222–233¾, 498–514, 894–905, etc.). Every distinct external cause we have seen to possess certain peculiarities, or as two or more may operate, and according to their individual or combined properties the nervous power will be modified and thus governed in its production or removal of disease, so far as this agent is concerned; and the same philosophy applies to those internal remote causes which consist of the various forms of local disease, or any other internal cause, such as the passions, when they exert morbific effects. In the former cases the effects depend upon *reflex* actions of the nervous system, by which the modified nervous power is brought into alterative action; in the other series of cases, or that of the passions, and diseases of the nervous centres, the development of the modified nervous power is not *reflex* but *direct*. The philosophy is, however, as I have shown, precisely the same in both cases, the only difference being that in the one, or that of *reflex* action, the sensitive nerves participate, while they do not in the other. The latter, therefore, I designate as *direct* action, or *direct sympathy*, the former as *remote* and *contiguous sympathy*, or, simply, *sympathy*. These terms, and *sympathetic influences* also, are wanted to express the functional influences of the foregoing processes, especially their morbific and therapeutical, and as being brief and comprehensive. The terms *remote* and *contiguous sympathy* were introduced by John Hunter, and predicated of the phenomena, and their import is perfectly understood, even by the community, and *sympathy* as far back as Hippocrates, and are exactly adapted to all that has been recently ascertained as to the nervous mechanism through which the function is performed, whether *reflex* or *direct* (§ 222–233¾, 495–500 *l*, 500 *o*–514 *m*, 638½, 894–905, etc.).

THE HUMORAL PATHOLOGY.

819, *a.* "To what errors have not mankind been led in the employment and denomination of medicines? They created *deobstruents* when the theory of obstruction was in fashion; and *incisives* when that of the thickening of the humors prevailed (§ 748, 789). The expressions of *diluents* and *attenuants* were common before this period. When it was necessary to blunt the acrid particles, they created *inviscants, incrassants,* &c. Those who saw in diseases only a relaxation and tension of the fibres, the *laxum* and *strictum* as they called it, employed *astringents* and *relaxants* (§ 569, *b*). *Refrigerants* and *heating* remedies were brought into use by those who had a special regard in diseases to an excess or deficiency of caloric (§ 433, &c.). The same identical remedies have been employed under different names, according to the manner in which they were supposed to act. *Deobstruent* in one case, *relaxant* in another, *refrigerant* in another, the *same* medicines have been employed with all these opposite views; so true is it that the mind of man gropes in the dark, when it is guided only by the wildness of opinion" (§ 4) —BICHAT'S *General Anatomy applied to Physiology and Medicine,* vol. i., p. 17.

"Among physical people," says Hunter, "we find such expressions in common use as, the *humors are affected in the blood; sharp humors in the blood; the whole humors being in a bad state; the whole blood must be altered, or corrected;* and a variety of such expressions *without meaning.* They even go so far as to have *hereditary humors,* as gout, scrofula, &c.; and make us the *parents of our own humors,* saying that *we breed bad humors.* Humors are even supposed to gravitate to the legs slowly; and, in short, the whole theory of disease has been built upon the supposition of humors in the blood, or *the blood itself being changed.* I cannot conceive what is meant, unless it be that *a strong susceptibility to a specific disease exists;* as small-pox may bring on scrofula, or a strain the gout."—HUNTER'S *Lectures on the Principles of Surgery,* 11th.

Affirmative.

1. "Various animal poisons, such as those of the snake tribe, and different mineral poisons, as mercury, for instance, act upon the blood. Those derangements of functions and organs produced by the experimenter, when he introduces different deleterious substances directly into the blood, are *likewise those* that are produced by the *sting* or *bite* of certain animals; they are *also those* that take place in *small-pox, measles,* and *scarlatina,* of a malignant nature, as it is called. They are *the same derangements* that appear in persons exposed to putrid emanations, vegetable or animal, and to miasmata from the bodies of other persons that are themselves diseased and crowded in confined places, &c. Lastly, *they* show themselves, also, in individuals whose blood is only imperfectly or badly repaired by *insufficient or unwholesome diet.*"

2. "There takes place a *vitiation* of the blood by the commixture of deleterious substances; *next, in consequence* of such vitiation, an alteration of the functions of the nervous system; and, *lastly,* the blood that supports the organs, and the nervous system that animates them, having suffered a general injury, a constant, though not always appreciable, modification of these organs in *their functions,* or in their texture."

3. "Diseases, resembling many of the preceding (no. 1) in their symptoms, or in the appearances discovered after death, are not unfrequently occurring where no *deleterious substance has been introduced* into the blood, and in which there is no direct proof that any alteration of that fluid has been the *primary cause* of the morbid phenomena. Here, as in the preceding case (no. 1), it appears that the *primary cause* of the disease *should be referred to the blood,* which in this

Negative.

4. "The VITAL FORCES appear to be affected *primarily* by a great many poisons, by the vegetable or animal emanations, known by the name of miasmata, and by various modifications of the external agents which are incessantly acting upon us, such as a want of due exposure to the sun, too damp an atmosphere, and *an unwholesome diet.*"

5. "In *every* disease not immediately produced by external violence, the symptoms that occur depend either on *a lesion of the forces that animate* every living part, or on a lesion of organization (§ 177, 189 *b*). *The former is primary and constant;* the latter is secondary, variable in its nature, and inconstant in its existence."

6. "No one solid can undergo the slightest modification without producing some derangement in the nature or quantity of the materials destined to form the blood, or to be secreted from it."

7. "Until it is PROVED that the forces which, in a living body, INTERRUPT the play of the natural CHEMICAL AFFINITIES, *maintain a proper temperature,* and PRESIDE OVER the various actions of organic and animal life, are analogous to those admitted by natural philosophy, we shall act CONSISTENTLY with the principles of that science, by giving *distinct names* to those TWO KINDS OF FORCES, and employing ourselves in calculating the DIFFERENT LAWS they obey."

"The qualities of pus are modified by every alteration, whether physiological or pathological, which takes place in any other organ, even though it have no particular connection either of function or tissue. Thus we have all seen instances of the pus secreted by the surface of a sore becoming suddenly altered in quantity and quality

Affirmative.	*Negative.*
case, has altered its nature under the influence of *unknown causes*, as it has in the others, in consequence of the commixture of various substances."—ANDRAL'S *Pathological Anatomy.*	under the influence of a simple moral emotion, of the process of digestion, or, in short, of any supervening disease. Nay, farther, there are certain constitutions, certain idiosyncrasies, which modify the qualities of pus, and in which it constantly assumes a peculiar and determinate character."—ANDRAL'S *Pathological Anatomy.*

819, *b*. I HAVE thus brought into contrast the prominent doctrines of the distinguished individual who enjoys the honor of having restored the humoral pathology, with the same intentions that led me to a similar display of the chemical philosophy in its applications to physiology, pathology, and therapeutics, according to the exact quantitive method of the laboratory (§ 350, 350$\frac{1}{4}$, 350$\frac{1}{2}$, 350$\frac{2}{3}$, 350$\frac{3}{4}$ *a–gg*, 438–442, 447 *f*–448 *f*). I have done this, I say, because of the general alliance of the whole philosophy, and its almost universal sway in Great Britain and France, urged on by the powerful influence of the Parisian School, of the British Association for the Advancement of Science, of the British and Foreign Medical Review, the Medico-Chirurgical Review, the London Lancet, and other periodicals of less importance (§ 5$\frac{1}{2}$ *a*, 349 *d*, 350$\frac{3}{4}$ *k*, *kk*, 709, *note*). In considering the causes which have led to the subversion of medical philosophy, we should steadily distinguish the projectors from those who give the impulse and who govern public sentiment. It will be readily seen by every discerning mind, from my analysis of doctrines, and from what I have shown of the absence of all method, of all consistency, and the manifest want of any definite conceptions, in the chemical and physical doctrines, from the intermixture of vitalism, solidism, chemistry, humoralism, mechanical philosophy, &c., as the basis, individually and collectively, of exactly the same laws, that if the systems which are thus projected had been permitted to address themselves to the reason of mankind truth would have enjoyed, at least, an equal chance with error. But, the opposing school decided that it should be otherwise; and nothing remains, therefore, to the few who have been thus overlooked in the haste, but to disarm, if possible, the adversary, and turn his own weapons against him. These weapons, in the phraseology of science, are facts, and upon his own "facts" the great questions at issue might be safely rested. The whole matter, indeed, must ultimately turn upon this species of evidence. The theories naturally follow. As the mind becomes enlightened about the nature of the premises, there will be no difficulty in distinguishing between the fair and the false in theory. In all medical philosophy, where so much is controverted, truth cannot be attained without a simultaneous survey of the ground-work of error as well as of truth; or if the latter take its chance upon its Heaven-born rights, it is sufficiently known that it cannot remain long in the ascendant (§ 1 *b*, 5$\frac{1}{4}$ *c*).

820, *a*. I thought it an object of importance to examine the whole ground of the humoral pathology in the former work, which I had devoted to the high branches of medicine, according to the best of my humble efforts. I shall now rather invite an attention to what I have there presented, than enter again upon any circumstantial view of the subject. But, independently of the important objects set forth in the preceding section, the present work would be defec-

tive in its plan, should all regard be neglected for a doctrine so widely embraced by the educated physician in common with the ignorant pretender, and so broadly opposed to the solidism which lies at the foundation of these Institutes (§ 1 *b*, 350¼).

Moreover, there was not extant, till the appearance of the *Commentaries*, any representation of the doctrines of Humoralism, excepting such as might be gathered from the writings of its masters, or from disquisitions of a desultory nature by its opponents.

820, *b*. The restoration of humoralism is an impressive exemplification of the popularity of simple views when brought into contrast with systems of philosophy that concern profound institutions of Nature, since it unavoidably associates itself with that identical ratiocination which is the parent of empyricism, but which the more enlightened party can only recognize as the offspring of ignorance.

The essential facts, however, which are relative to the great foundations of Nature, especially in her organic department, have been too familiarly known, and their laws too well comprehended, to admit of any important innovations in medicine that shall long retard its progress, or rescue the projector from a certain oblivion. The beaten path is the only road to usefulness and enduring fame; but to achieve the latter requires the patient toil of the botanist who looks for eclat in the discovery of an unknown plant within the environs of London. Enlightened genius attempts no other route. It is alone the ambition of narrow mind, or the conceit of genius in its limited observation, that aspires at revolutions in philosophy. Hence the desertion, by the former, of that path for the old by-ways which lie obscured in the mists of antiquity; while the latter strikes out systems of such eccentricity as command, for awhile, universal admiration (§ 350, 350¼, 350½).

820, *c*. Without, however, attempting now, as on a former occasion, to assign more extensively the ground of the foregoing conclusions, I shall briefly add that I know of no recent attempted innovation upon the philosophy of organic nature, whether under its healthy or morbid aspects, and as that philosophy recognizes the principles of vitalism and solidism, but has prevailed more or less at former eras, and has been so abandoned and eradicated that it now comes up again with the interest and power of novelty. And it comes to us again without having changed in one essential aspect its old thread-bare livery. That this should be so is owing to the absence of all efforts to refute the errors, excepting as transiently made in the form of opinions, and imbodied in the perishable journals of the day.

821, *a*. The humoral pathology having higher pretensions, from its dignified relations to the past, than its kindred hypotheses, should always secure for itself a patient hearing, and a full refutation (§ 1 *b*, 350¼, and RIGHTS OF AUTHORS, p. 919, no. 21).

821, *b*. In the brief review which I now propose the question should be first settled as to the main doctrine of the present humoralists. This was so accurately done in my Essay on the Humoral Pathology that the Medico-Chirurgical Review, which was addicted to that Pathology, quoted my exposition of the main principle, and allowed that it was "fairly stated." The following is the passage:

"The question at issue is not, whether the blood becomes diseased by a morbid action of the solids; and the solidist is surprised that the

defense of humoralism should often turn upon labored attempts to prove what every body admits. Nor is it, whether vitiated blood, or putrid matter, will excite disease when injected into the veins. The question at issue is, *whether foreign morbific causes, and remedial agents, in their ordinary modes of operation, produce their primary effect upon the solids or upon the blood, and the latter become the cause of disease in the former; whether we 'have hereditary humors, as gout, scrofula,' &c., and whether we are 'the parents of our own humors, and that we breed bad humors,'*" &c.—*Med. and Physiolog. Comm.*, vol. i., p. 636.

In the same Essay I have quoted many recent authors, as setting forth the doctrine in exact conformity with its ancient impurities, and as promulgated in the newspapers of the day. A paragraph embraces all that is essential in the science of medicine; or, should the facts, the basis of the science, form an accompanying part, the whole is comprised within a moderate pamphlet entitled "*Organic Chemistry in its Application to Physiology, Pathology, and Therapeutics.*"

821, *c.* It may be interesting to some should I annex the precise *modus operandi* of morbific agents, as expressed in almost every work, ancient and recent, which recognizes the humoral pathology. The learned and distinguished Dr. Hosack shall speak for the school and its imitators. Thus:

"That 'a little leaven leaveneth the whole lump' *is as true in fevers as in making bread*, or in the conversion of acescent fluids into acetic acid; and *that* upon the *same principle of assimilation.* That one spoiled herring will taint the whole cask, is well known to every housewife or fish-monger. Hence the great care of the Dutch in their herring fisheries to salt down their fish as soon as they are taken. They never permit the sun to rise upon them" (§ 830, *b*). And so, also, the chemists (§ 350, nos. 44, 45).

Although, as will be seen by the references, the exact chemical school differ from the foregoing in respect to the *modus operandi* of the *mind* and *passions*, they agree as to the physical agents; even to the Dutch herring (§ 349 *e*, 350, no. 44, &c.). So far as these illustrations go, it must be in justice admitted that they are peculiar to the walks of science, and are the rightful trophies of "experimental philosophy." "*Qui meruit palmam,*" &c.

In connection with what I have now said should be taken the details of the philosophy as expounded by its late restorer, which may be seen in the introductory matter, and in subsequent sections.

Such, then, by universal admission, is the philosophy of humoralism; and that it has no better foundation I have endeavored to demonstrate in my former Essay (§ 4, *b*).*

822. On the other hand, what says the solidist? He tells us that, however simple the foundation (§ 638), disease and its cure depend upon the most intricate system of laws; far beyond any thing in the inorganic world: That these laws are associated with properties which are peculiar to organic beings, and determine all their natural processes: That all morbid conditions consist essentially in alterations of the properties and functions of the solid parts: That alterations of the blood are only consequences of these essential changes: That all practical medicine consists in restoring these solids to their nat-

* The philosophy and illustrations (including "the stimulating plan") remain unchanged, 1860.—*Vide* the late and standard British works of F. W. Headland, R. B. Todd, and J. H. Bennett. Also, *notes* p. 462, 872.

ural state, without reference to the existing condition of the blood, excepting in the aspect of symptoms: That it is only through the agency of the renovated solids, whose morbid state had affected the condition of the blood, that this fluid can be in any respect diverted from its modified conditions, or restored to its integrity.

Finally, we are told by the solidist that medicine, in any one of its branches, cannot be taught in the compass of a pamphlet.

823. There are some eight or nine principal positions taken by the present humoralists in the way of tangible proof. With the exception of the second following, they are the same as are disseminated in the books of the older writers. They are now, for the first time, condensed into a methodical order from extended disquisitions in the Commentaries; namely:

1. That substances deleterious to life have been known to be taken into the circulation through the lacteals (§ 826).

2. That gaseous and fluid substances, having an affinity for each other, permeate and unite through a dead animal membrane (§ 827).*

3. That morbific agents, when inserted in wounds, give rise to diseases in various parts (§ 828).

4. That injections of various substances, and morbid blood, into the circulation, produce disease in the solids, and occasion death (§ 830).

5. That when many substances, as salt and acids, are mixed with the blood out of the body, they affect its sensible character apparently like the changes which happen to the blood when circulating in the living organism (§ 832).

6. That when certain substances, such as yeast, are added to dead organic compounds, like vegetable infusions and dough, they create an intestine commotion. The example of a putrid fish, which is of the same nature as the preceding, contaminating a barrel of sound ones, has been lately, as formerly, adduced in high quarters to prove the soundness of humoralism (§ 833).

7. That the blood, in certain conditions of disease, undergoes changes in its appearance; especially in refusing to coagulate, and in being of a dark color; and that chemists, also, have sometimes detected a variable composition (§ 834, p. 780, § 1029).

8. That morbid changes occur in the secreted and excreted products (§ 835).

9. That diseases are transmitted from parent to child (§ 836).

10. That remedial agents, when injected into the circulation, sometimes produce the same effects upon particular organs as when administered by the stomach (§ 837).

11. That certain vegetable tonics, containing an astringent principle, will increase the physical strength of dead muscles, vessels, membranes, &c. (§ 842).

824, *a*. So far as my knowledge extends, the foregoing admitted facts constitute the entire foundation of humoralism; and it will be seen that not a single one of them has any sound relation to physiol ogy! But what do they prove? Nothing whatever beyond the sim ple fact affirmed by each proposition (§ 5¼). No one of them has the least bearing upon the questions relative to the natural operation of morbific causes, nor of remedial agents when employed according to the only methods that are sanctioned by nature or by art. We have also before us a remarkable display of the general habits of mankind

* By a violent process it may be done through a living one.

in respect to the value of evidence in that sense which Nature has ordained as the basis of her institutions. Here we see nothing but a factitious assemblage of analogies for the foundation of great principles in medicine, devised by those very philosophers who condemn all conclusions in this science that are predicated, in other systems of philosophy, of those analogies which are impressed upon the face of Nature. Nor is it less worthy of remark, that the school in chemistry, who aspire at more exact applications of analogy to the healthy and morbid processes of the living being, borrow the whole from the inorganic world, and, for its better success, condemn this method of induction as employed by the vitalists in their study of organic phenomena.

824, *b*. Most of the foregoing premises in humoralism are brought into view in various parts of this work in their appropriate relations to special principles in physiology, pathology, and therapeutics; and the subjects are too extensive for elaborate consideration. In the Essay embraced in the Commentaries they have been subjected to all the examination which farther experience and reflection would enable me to bestow.

825. Humoralism, however, has now become so generally prevalent, and is sustained by so powerful an array of "authorities," and as my own writings afford the only systematic view of the subject, I shall, for the advantage of the young inquirer, present such a condensed and connected statement of my grounds of objection as will enable him to comprehend the misapplication of facts, and to apply them in the manner which appears to have been ordained by nature (§ $5\frac{1}{4}$). I shall, however, introduce other facts and arguments, that they may be taken in connection with the former, and shall simplify the subject by adopting a method in conformity with the foregoing propositions (§ 823). But it will be my object to bring into view the great principles which bear upon the several specific statements, either directly, or by reference to other sections. These references, therefore, will form an important part of the investigation, as they connect it with various principles and facts in physiology (§ 639, *a*).

826, *a*. As to the first proposition, that substances deleterious to life have been taken into the circulation through the lacteals, I object, that the phenomenon is rare, that it has been mainly ascertained of certain mineral substances, and that these, as allowed by the chemists, are eliminated by the kidneys in from five to fifteen minutes after their absorption (§ 280). The lacteals, on the contrary, elect, with astonishing precision, the nutritive chyle, and reject the rest. This is due to the exquisitely-modified irritability of these vessels; just as has been seen of a like provision in the glottis, the pyloric orifice, and vessels which exclude the red globules of blood (§ 191, 192). Nor can we too much admire the Wisdom which embraced in one universal Design the general good of the organism by so endowing the lacteals that they shall exclude all things which are not in harmonious relation to the special vital states of every other part (§ 274–295).

When such substances effect their entrance through absorbing vessels, it is, as we have seen, by modifying their irritability, and thus establishing relations with them; just as undigested food escapes a morbid pylorus, or the red globules of blood enter the serous vessels in inflammations. Bile, &c., are incapable of producing such modifi-

cations of the lacteals, and are, therefore, forever excluded. Here, too, morbific or remedial agents act in their concentrated state, and supply a ground for interpretation, through reflex nervous action, of the remote phenomena; while the little that may gain the general circulation is so diluted, and so soon excreted, as to be worthless in our estimate of causes (§ 1089).

826, *b*. It should be also considered, that, notwithstanding the rapidity with which foreign matter at all offensive to the organism is eliminated by the excretory organs (§ 280), the blood and entire body may have undergone many renewals between the application of the predisposing cause and the explosion of disease; that hydrophobia may not supervene for months or for years, fever for a year or more, and may then return at annual periods; that salivation may follow a very minute quantity of mercury, and may be continued long after the saliva and other secretions have flowed in great redundancy, &c.; while, on the other hand, the interpretation of their modus operandi, according to the philosophy which I have propounded, is in perfect harmony with every principle advanced in these Institutes, and invites the severest scrutiny. In connection, also, with these topics should be considered all that I have expounded of the laws of sympathy, vital habit, constitution, acclimation, temperament, &c. As to the oft-alleged smell of garlic in the excretions, of the coloring matter of madder in the bones, or of the bile in all parts of the body, they are among the most attenuated of material substances, and are inoffensive to the lacteals and the general organism. (See, also, *Med. and Physiolog. Comm.*, vol. i., p. 523–557, 576–581, 589–594, 599–608, &c.)

826, *c*. Nor should it be neglected, that there is no agreement among chemists as to some of the most important morbific and remedial agents which have been said to gain a ready admittance to the circulation.

826, *cc*. Why is the pulse always consulted in all forms of disease and after all remedies? Is it to find out how far the blood is affected, or whether the remedies be duly absorbed, or whether the heart or arteries be the seats of disease? Consider the unceasing modifications of the heart's action, and of the arteries too, as brought about by diseases of all parts, and by medicines, and by mental emotions, and mark the coincidences, and you will allow that you "feel the pulse" simply to learn the nature of the reflex nervous influences which remote diseases inflict upon the circulatory organs, and to thus find out the nature and force of those diseases, or equally in the case of medicine what reflex nervous influences they institute either mediately or immediately. If such, then, be our objects in feeling the pulse, why is not the same philosophy applicable when diseases spring up consecutively, or when morbific causes, acting upon surfaces, light up diseases in the internal organs? In the former cases you "feel the pulse" for the purpose alone of ascertaining the nature and extent of the disturbing or moderated reflex nervous actions, whether you know it or not, and in the latter cases the analogy is supported by all the pathological and therapeutical facts, and especially so by the staring fact that powerful irritants, like tartarized antimony, which occasion violent disturbances when conveyed into the circulation, break down inflammations and high arterial excitements when applied to the intestinal mucous membrane (§ 829, 902 *g*, 904 *bb*).* Why is the tongue, like the pulse, always expected to supply information as to the diseases of other parts and the

* The universal custom of "feeling the pulse" is a remarkable example of an equall universal unconsciousness of the philosophy which relates to the subject.

salutary or injurious effects of remedies? Can any other rational solution be offered than that which I have presented in relation to the heart and arteries (§ 500 *m*, 687½–688, 694¾, 840, 891½ *k*, 892¾, 893)?*

826, *d*. We should not be led into the error of confounding the results of agents applied to the trunks of a nerve and to its extremities. The physical philosophers have taken advantage of the comparative failure of the former to show that morbific and remedial agents do not produce their remote effects through the medium of the nervous system, and have adopted this view from Müller's misapprehension of the subject. "The narcotic action of opium," says Müller, "does not react from a particular point of a nerve on the brain." Therefore, argue the materialists, when applied to the surface of tissues, its narcotic effect is due to absorption. But the great Physiologist has shown, himself, the error, while, at the same time, he proves the untenable nature of humoralism. Thus:

"The spirituous extract of nux vomica, introduced in a small quantity into the *mouth* of a young rabbit, produces immediate death (in a second of time); whereas, when applied to a nerve at some distance from the brain, for instance, to the ischiadic nerve, it produces no general symptoms" (§ 494 *dd*, 498 *c*, 514 *d*).

There is the broadest distinction between the trunk of a nerve and its expanded extremities in connection with organic tissues; while, also, the organic properties of the terminal fibres, and especially sympathetic sensibility (§ 201, 451 *d*), are incomparably more strongly pronounced than in the nervous trunks. The important consideration has been also neglected that two orders of nerves are concerned in the function of remote sympathy as it occurs naturally, and that the points of departure and of incidence are the expanded portions of the nervous system. This is also undoubtedly true even of the sympathies of the nervous system itself, which embraces all the elementary parts of other organs (§ 472, no. 4, 514 *d*, 516 *d*, 526 *d*. Also, *Med. and Phys. Comm.*, vol. i., p. 507, 563–566).

Moreover, when irritating, or other agents, produce strong impressions upon the surfaces of organs, it is not, as supposed by Müller and others, mainly upon the ramifications of the nerves, but may be equally, at least, upon the organic properties of the other tissues of the part (§ 184, 188). Hence, particularly, the wide difference in the effects of irritants, &c., when applied to the trunk of a nerve and to an organ of a different vital constitution; as shown, for example, in the action of vesicants (§ 133, &c.). The insusceptibility of nervous trunks is also farther shown by their remarkable exemption from the action of morbific causes (§ 526, *d*).

827, *a*. The second fundamental proposition of humoralism is in part that gaseous and fluid substances, having an affinity for each other, permeate and unite through a dead animal membrane.

That fact is undeniable. But what is its physiological aspect? Is it worthy, in any other than its naked relations to chemistry, of grave consideration? And so of the entire amplitude of *endosmosis* and *exosmosis*. There must first be shown a correspondence between a dead, permeable tissue, and a living, impermeable one, before we can proceed to apply the foregoing fact in any physiological bearing. But its utmost latitude would only show that foreign substances unite *chemically* with the blood through the living tissues. It is true that,

* See NOTES I p. 1118, LL p. 1140.

more recently, active chemical agents have been brought to bear in a corresponding manner upon living tissues; but the violent influences which have been thus set in operation render these experiments as worthless as the original ones. It is equally a perversion of nature.

827, *b*. Of all the agents which surround us oxygen gas is the only one which has been shown, with any degree of plausibility, to penetrate a living animal tissue, or to unite chemically with the blood, or with any supposed constituent of that fluid. If it be allowed, also, that this has been demonstrated, nothing can be predicated of it analogically in respect to other extraneous matters, since it is an ordained function of organic life, under the control of specific laws in the animal and vegetable kingdoms, and conducted through special parts of the organism. The philosophy is the same as we recognize in all other parts. It is the office, for example, of the chylopoietic and sanguiferous organs to rearrange the elements of food, and endow the new compounds with the properties of life; while it is that of the glandular organs, the membranes, &c., to select certain constituents from the common homogeneous mass by virtue of these vital properties, and to impress upon them various peculiarities, according to the mechanism of each tissue, and as the vital constitution of each part may happen to be modified (§ 18, 42–44, 133, &c.).

Coming again to the specific uses of oxygen in the organic kingdom, the relative laws, the organs, the final causes, &c., are also different in the two organic departments, and even varied as to organization in animals; yet in all according to other variations in the general physiological constitution (§ 133–151, 185, 259–295, 409, 410).

But, I think it must be conceded that I have shown that there is no physical penetration of the pulmonary mucous tissue even by oxygen gas, and that the formation of carbonic acid within the lungs is primarily due to a strictly physiological process (§ 135, 419, 433, &c., 447½ *a–f*).—Notes N p. 1121, R p. 1123.

I am now conducted to a fact which illustrates the principle on which miasmatic poisons operate.

It is well known that adult dogs, &c., will bear without injury a suspension of respiration for the space, at least, of five minutes. But they perish immediately if plunged into carbonic acid gas. Therefore, say the humoralists, the gas is absorbed in the latter case, which makes the difference in results. This, however, is contradicted, in the first place, by the ordination of nature that carbon shall be evolved from the lungs, and by an organization of the mucous tissue of the lungs corresponding to that fundamental law; whether the process be the result of chemical or vital actions, or both united (§ 447½, *f*). Organization is thus specifically opposed to the absorption of carbonic acid. As well might it be assumed that gastric juice is resorbed by the mucous tissue of the stomach. Carbonic acid, therefore, does not destroy by absorption and union with the blood (§ 419, 420).

But this incontrovertible philosophy is sustained by direct experiment; since it was found by Nysten that "carbonic acid gas may be injected into the venous system in large quantities, without stopping the circulation, and without acting primitively on the brain; but when more is injected than the blood will absorb, it produces death by distending the heart, as when air is injected into the veins."—Nysten, *Récherches*, &c., p. 88. This, however, is not the *modus operandi*.

Here, then, we have the principle demonstrated, which is of universal application to mephitic gases, upon whatever surface their action may be exerted. The poisonous action of carbonic acid is exerted upon the pulmonary mucous tissue, and then only upon the brain, as a consequence of that primary effect, and through the physiological relations of the mucous tissue of the lungs to the great nervous centre (§ 129, 137, 222, &c., 666. Also, *Med. and Physiolog. Comm.*, vol. i., p. 443, &c.). This lets us into the secret why certain poisons, as that of the viper, of the mad dog, and some others, have no action upon the stomach, or when applied to the surface of the brain, but operate with violence when inserted within the organization of the skin, and why that of the rhus vernix, &c., will affect the skin when applied only superficially (§ 135–137, 140, 150, 904 *b*).

Again, in connection with the foregoing illustration, it is an important fact that animals may be destroyed by the application, for a considerable time, of carbonic acid to the skin, although free respiration of atmospheric air be permitted. This shows that it may also exert a deleterious action upon the organic constitution of the skin; and by analogy, therefore, such may be more or less the case with malaria. And it should be farther stated, that the action of carbonic acid agrees, also, with that of concentrated forms of malaria in the instantaneousness of its effects (§ 654, *a*).

827, *c*. An almost endless series of examples of clear, definite character illustrate the philosophy of more obscure but analogous problems. Another, for instance, may be found in the effects of the nitrous oxide gas, when respired. Here, the immediate production of the phenomena, and more especially the abruptness with which they subside, prove that the whole action of the gas is upon the pulmonary mucous tissue, and that the general phenomena can be in no respect owing to a modified state of the blood, however the gas may be absorbed. And just so with the respiration of ammonia, which brings on coughing, rouses the circulation, &c., instantly, and which cease as instantly on removing the exciting cause. The example of cold in producing pneumonia, or rheumatism, &c. (§ 649 *c*, *d*, 657, 666), the fatal action of hydrocyanic acid, aconitina, strychnia, &c., the remedial influences of tartarized antimony, of the mercurials, and of numerous other alterative agents, concur in one general illustration of this subject (§ 494 *dd*, 550–563). The philosophy relative to reflex nervous action conducts us through all the labyrinth of the wide-spread influences that radiate from a given point which may seem almost alone exempt from the general invasion of disease (§ 222, &c., 500, 904 *b*, 1066 *a*).—Note M p. 1120.

827, *d*. The present place supplies a good opportunity for introducing a case of death from hydrocyanic acid; partly with a view to our present subject, and to serve, in part, as a reference to illustrate other topics. Thus:

A medical gentleman had swallowed a fatal dose of Scheele's hydrocyanic acid, from which he died in about ten minutes. "On cutting into the right lung, a frothy, dirty-brown semi-mucous fluid exuded, tinged with blood. There was no odor of prussic acid from it. In the cavity of the right pleura were about eight ounces of thin serum. The left lung was firmly adherent in its whole extent to the costal pleura. Heart firmly contracted. It exhaled no smell of prussic acid Liver healthy. Spleen soft and easily broken down, resembling mul-

berry jam. Kidneys natural. The stomach contained about fifteen ounces of half-digested food, that gave out the well-known odor of bitter almonds. The mucous coat of the stomach healthy, and *smelled strongly of prussic acid* after the stomach had been emptied of its contents (§ 657). Intestines healthy. *Vessels and sinuses of the brain filled with a dark-colored fluid blood.* No smell of prussic acid. Blood every where fluid" (§ 494, 904 *b*).—Mr. Pooley, in *London Medical Gazette*, 1845.—See notes, p. 172, 863.–§ 1066, 1088 *a*, *b*.

827, *e*. The foregoing philosophy enables us to understand why the morbific action of miasmata is promoted by various causes which increase the susceptibility of the system (§ 663), and which has its parallel in numerous examples of daily occurrence; as the greater liability of mercurial agents to produce salivation if we increase irritability by cathartics, blood-letting, &c. (§ 556 *c*, 630 *e*); while, on the contrary, had humoralism any foundation, cathartics and blood-letting should diminish the chances of mercurial action, nor should that action increase long after profuse ptyalism has been established. The warm bath promotes the constitutional action of mercurial ointment by increasing the susceptibility of the skin and system at large (§ 1088 *b*, *c*).

It should be observed, also, that upon the hypothesis of humoralism there should be no exemption of individuals from epidemic diseases, since the blood of all should be equally liable to contamination. Humoralism may not, consistently, assign as the ground of exemption a difference in the susceptibilities of the solids which have been induced by other causes (§ 651 *b*, 657 *a*, 837 *b*); and since, therefore, the blood is the *pabulum vitæ*, and convertible into the solids, it should, upon the humoral doctrine, when itself diseased, occasion universal disease of the solids (§ 663). The same is also true of the poisons, of the prick of a pin, &c.; but always affecting some severely, and others slightly,—the former sometimes striking at one organ, and again at another, while the latter induces in one man erysipelatous inflammation, in another always phlegmonous, and in a third none at all (§ 652 *c*, 828 *c*, 494, 740, 741).—Note Oo p. 1141.

827, *f*. If, however, it be admitted that offensive substances when absorbed operate through the medium of the circulation, solidism and vitalism can alone interpret the phenomena. There is abundant proof that the results are not due to any affection of the blood, but must be referred to the direct action of the agents themselves upon the vital constitution of the solids to which they are distributed. This construction of the subject, therefore, is directly within the pale of solidism; though it be foreign from the truth (§ 284, 904 *c*).

827, *g*. Again, however, most of the substances whose presence in the blood or secretions can be detected (*a*) are either innoxious, or undergo chemical decomposition as soon as they come in contact with the circulating mass, and would therefore either be rendered inert, or would certainly give rise to different phenomena from those of the agents in their original shape (§ 52, 149, 650).

827, *h*. But this part of the doctrine of absorption does not end with gaseous substances; since there are some distinguished philosophers who maintain that *seeing* is produced by the penetration of light to the recesses of the brain, where it gives rise to certain cerebral changes that result in vision; just as Liebig and his school suppose that all the operations of the mind are determined by chemical chan-

ges of the brain (§ 349 *e*, 350½ *n–q*). By the analogies of Nature, therefore, we must conclude that, whatever gives rise to other sensations must be equally absorbed and conveyed to the sensorium commune,—the odor of plants, the undulations of air, the prick of a pin, &c. (§ 837, *b*). If this be frivolous it is not the fault of the logic.

828, *a*. The third proposition of humoralism sets forth, that when morbific agents are inserted in wounds they give rise to diseases in various parts.

Here, then, we have something besides ordinary surfaces. The "facts" which I have considered in the preceding propositions were evidently unsatisfactory to "experimental philosophy," and, therefore, a start has been given to absorption by inserting the noxious agents within the vascular systems. But, I have gone extensively, in the *Commentaries*, into the proof that in all the cases of this nature the agents have been either violently forced into the torrent of blood, or that their direct effect is exclusively upon the injured part, and thence by reflected nervous actions over the system. It will be also observed that in these experiments the agents are brought into direct contact with parts where the organic properties are most exquisitely developed and susceptible. The time of incubation (§ 666) may be from an instant, as with hydrocyanic acid and strychnia (§ 350½ *p*, 494, 743, 826 *b–d*, 827 *d*, 904 *b*), to a year or more, as with the cause of intermittent fever (§ 561, 657), or even to years, as with the hydrophobic virus (§ 547, 559, 560, 654–659, 500 *o*, 503, 506, &c. Also, *Comm.*, vol. i., p. 496–506). As to the last, the virus can neither remain in the wound, nor circulate in the changeable body for months, or for weeks. It is either washed away from the former, or carried off by the latter.—NOTE AAA p. 1146.

Now all these cases are exactly upon a par so far as principle is concerned. The same influences obtain in respect to the hydrophobic virus as with those agents which destroy life as soon as they come in contact with the body. This is the work of the nervous power; just as it is when joy, or anger, or a surgical operation, or blows on the stomach, &c., kill in an instant of time (§ 227, 230, 234 *e*, 476 *h*, 509–511). The principle is the same as when the division of a nerve excites inflammation in the part to which it is distributed. And all this conducts us, at once, to a knowledge of the *modus operandi* of the poison of venomous animals in the following comprehensive case.

828, *b*. "I have seen," says Dr. Johnson, the late distinguished editor of the Medico-Chirurgical Review, "the ear of a rabbit exposed to the bite of a cobro de capella, with a pair of scissors kept across the ear, ready to cut it off the moment the bite was inflicted; yet the animal died quickly in convulsions" (§ 234 *e*, 507, 827 *d*).

The foregoing fact corresponds exactly with experiments of a very different nature by Van Deen, Stilling, Budge, &c. (§ 494), and forms, with those, substantial grounds for analogical inductions. They may be safely considered of universal application, whatever the morbific cause, whatever the interval of predisposition.

828, *c*. It is astonishing, too, with what rapidity certain morbific causes will establish inflammation, and thus lead to an almost instantaneous disorganization. Take another example from the venomous serpent, as related by Sir E. Home. He caused a rat to be bitten by a snake. It died *in one minute*. The cellular membrane beneath

the wound was wholly destroyed, the muscles separated from the ribs and from a small extent of the scapula. The bitten part was greatly inflamed.—NOTE AAA p. 1146.

Here the inflammation must have commenced in the region of the thorax at the moment the bite was inflicted. Absorption and distribution were, of course, impossible, and there is nothing but the philosophy which I have propounded of the nervous power that will in the least explain the phenomena in this and all analogous cases (§ 222, &c., 234 *e*, 503, 509). By the foregoing case we are also prepared to understand that hydrocyanic acid may light up venous congestion in the brain, although it destroy with equal rapidity (§ 827, *d*).

828, *d*. Finally, an elementary example of universal application to morbific agents, and illustrative of the nature of life, will supersede the necessity of farther comment upon the three fundamental propositions of humoralism as it respects absorption (§ 823). This example is of the same nature as that of the *seton*, farther on; but more open to the understanding of all (§ 905).

It will be admitted that when inflammation is excited by the puncture of a lancet, it is not by irritating, or otherwise affecting the blood; but that all the attendant phenomena are due to an impression made upon the solids, and to their consequent morbid action. The inflammation, thus excited, may be extensively and violently propagated along the part, as in phlebitis, &c. (I specify a vein, as it is here the acrid injections are made, § 830); and it is but reasonable to suppose that the same condition is owing to a similar cause at one or six inches from the wound, as at the eighth of an inch.* No sooner, also, does the inflammation begin than reflex nervous actions may ensue; but as we have no morbific blood in these cases, we must look for some principle, analogous to that in which the local changes began, to explain the general derangement (§ 500, 711, &c.). All this will help us to the philosophy of analogous developments in diseases of reputedly humoral origin. But, besides the common effects of inflammation the prick of the lancet may convulse the whole nervous and muscular systems (§ 222, &c.). Nay, more, and greatly to our purpose, the inflammation arising from a wound will be variously modified in its character by the exact nature of the wound itself, and the kind of instrument or violence with which it is inflicted (§ 652, *c*).

If there be now added to the point of the lancet sulphuric acid, or the virus of putrid animal matter, of the small, or cow-pox, or the poison of the viper, of the wourari, &c., there will be many diversities in the general results of the several causes thus superadded to the mechanical, but strong resemblances in the local phenomena, and in the progress of symptoms. The specific products, also, as well as other circumstances, denote specific modifications of a common pathological state (§ 722, &c.). If, then, the mechanical irritation in one instance have acted directly upon the solids, is it not a proper conclusion from the progress and analogy of symptoms, that the several varieties of poison have done so in the others? It cannot be said that certain differences in the results imply a difference in the principle, since all these results, where life is sufficiently prolonged, are purely secondary, and will be admitted to be consequent on the morbid affection of the solids. But all the primary phenomena in such instances coincide with each other, and have the same order of development.

* By continuous sympathy, or *continuous influence* of these Institutes (sec. 129 *c*, *f* 498 *a*).

If the poison of the viper destroy life with great instantaneousness, this is conclusive against absorption, and is exactly allied in principle to the fatal operation of a blow upon the region of the stomach, or of surgical operations which produce instant death, or of the prick of a pin which is followed by tetanus (§ 494 *b*, 509, &c.).

828, *e*. There is an endless variety of analogies where disease is excited by agents of a mechanical, or even of a more negative nature; such as cold, heat, wakefulness, fatigue, &c., which, like the operations of the mind or its passions, in producing or removing disease, killing or curing, according to the exact nature of the intellectual process, that are applicable with all the force of the strongest analogies to show that in all other cases the same laws prevail (§ 188½ *d*, 527 *b*, 902 *m*, 905). The laws of reflex nervous action explain the whole.

829. "When we consider," says Pereira, "the peculiarities attending the hepatic circulation, and that all the remedial agents, whose particles are absorbed, have to pass through the portal vein,—the vein by whose branches the bile is secreted,—*our astonishment is great* that this secretion is not more frequently affected *by the various medicinal agents put into the stomach*."—PEREIRA'S *Mat. Med.*, p. 92.

May we not, however, rather be astonished that the frequent exemption of the liver itself from all morbid effects, as well as the condition of the bile, did not satisfy our able author that the doctrine of remedial and morbific action by absorption is contradicted by the plainest facts (§ 889, *a*)?

Our author, however, has been led into an important physiological error by Magendie's assumption that the veins, and not the lymphatics, perform the office of absorption; while in respect to any ingress of deleterious agents, it is mostly by way of the lacteals (§ 277). Admitting, therefore, that the violent agents of the Materia Medica operate by absorption, they are first conveyed directly to the heart through the thoracic duct; and if "astonishment" be great in the mistaken case of the liver, how much greater should it be when we consider the realities of nature, and observe how often the exquisitely irritable heart remains unaffected when the most powerful irritants would be emptied into its cavities. Or taking the construction of our author, the effect upon the heart would be equally the same, since a large proportion of the portal blood is delivered at the same cavities. In either case, the irritants would exist in a state of concentration in the most irritable organ of the body compared with their dilution in other parts, except the lungs, as 1 to 50, or more. And yet the heart often remains undisturbed in its regular action after the administration of violent agents, while they are simultaneously healing, or inflicting disease on other parts. I present, therefore, this isolated fact as adequate in itself to a full refutation not only of the doctrine of morbific and remedial action by absorption, but, by the force of analogy, to that of the entire system of the humoral pathology. If embarrassing to the humoralists in the case of the inirritable liver, it is conclusive in that of the heart (§ 500 *m*, 638½, 826 *cc*, 840, 1089, 487 *a*, 904 *c*).*

830, *a*. The *fourth* grand assumption of humoralism, as a part of its basis, is the production of disease and death by the injection of various substances into the circulation (§ 823). These injections are made upon *animals*, and their effects carried up to the natural morbific causes which operate on *man*.

* Diseases have their *predisposing* and *exciting* causes (§ 645), and no one supposes that the latter are absorbed. Why, then, the former?

Strange as is this analogical ground of induction, it is, nevertheless, the great bulwark of humoralism. The doctrine is thus set forth by its restorer, M. Andral:

"Various animal poisons, such as those of the snake tribe, and different mineral poisons, as mercury, for instance, act upon the blood in the *same manner* as deleterious substances injected into the circulation." "Those derangements of functions and organs produced by the experimenter, when he introduces different deleterious substances directly into the blood, are *likewise those* that are produced by the *sting* or *bite* of certain animals; they are also those that take place in *small-pox*, *measles*, and *scarlatina* of a malignant nature, as it is called. They are the *same* derangements that appear in persons exposed to putrid emanations, vegetable or animal, and to miasmata from the bodies of other persons that are themselves diseased and crowded in confined places, &c. (§ 653). Lastly, they *show* themselves, also, in individuals whose blood is only imperfectly or badly repaired by *insufficient* or *unwholesome diet*" (§ 744, 819 *b*).

830, *b*. The order of results as stated by Andral, and as adopted by all humoralists, is the following:

"A *vitiation* of the blood by the commixture of deleterious substances. *Next*, in *consequence* of such vitiation, an alteration of the functions of the nervous system. *Lastly*, the blood that supports the organs, and the nervous system that animates them, having suffered a general injury, there takes place a constant, though not always appreciable, modification of these organs in their *functions*, or in their texture" (§ 709, 740, 744, 821, 847 *d*).

831. Injections of noxious agents into the circulation of animals were made to an almost incredible extent centuries ago; and millions, I may safely say, have been repeated in later times. But they prove only two things,—their short-sightedness and inhumanity. They certainly do not show, in the least, that the ordinary causes of disease are taken into the circulation, nor do they produce those constitutional affections which are generated by the natural operation of morbific causes, especially on the human species. Their action is commonly upon the venous system; and if the reader will refer to my remarks upon phlebitis, he will perceive the reason for the conclusion of many experimenters that they have given rise to yellow fever, typhus, &c., in the brute race (§ 744, 810, &c., 1088 *d*).

These devices of art are very extensively considered in my Essay on the Humoral Pathology, where I have endeavored to show that they all go to the proof of solidism (§ 827, *f*).—*In Med. and Phys. Comm.*

832. For an examination of what I have designated as the *fifth* proposition in humoralism (§ 823), I must refer the curious reader to the *Commentaries*, vol. i., p. 401–408, 431–451).

833. The *sixth* foundation is relative to the yeast and herrings; and the reader will probably be satisfied with the references to this subject which occur in § 821, *c*; otherwise, he may consult section 350, nos. 44, 45; and the *Commentaries*, vol. i., p. 417, &c.

834. The *seventh* fundamental assumption goes with the *fifth*, and the reader, by the references there, may satisfy himself of their degree of importance.

835. The *eighth* bulwark of the doctrine is the important fact,—important to the solidist,—that morbid changes occur in the secreted

and excreted products. Nor is it less important in its philosophical and practical bearings upon the humoral pathology; since it is undeniable that it places the learned and the unlearned practitioner on common ground. Their pathology is the same; and what is affirmed in the following extract of the educated, in respect to their practical habits, every newspaper in the land assures us is equally true of the pretender in medicine. Thus the extract:

"The humoral pathologist neglects the study of visceral lesions, and when he turns his attention to the digestive system, he only considers its secretions, and not its actual condition, or the state of its sympathies. His sole purpose is to evacuate sordes, or to produce a flow of healthy bile, and to eliminate depraved secretions; and this he attempts without possessing any knowledge of the effects of disease of the digestive system on other organs" (STOKES' *Theor. Prac. Med.*).

Professional humoralism assumes that these "vitiated secretions" are due to a morbid state of the blood, and not to perverted actions of the solids, which, in their ordinary state, give rise to the various natural products. And so the newspapers. Perhaps, however, the student may obtain some ideas to the contrary by consulting the following references (§ 42, 44, 53, 135, 220, 222–233¾, 284–292, 307, 314, 322–326, 327–331, 407–432, 452, &c., 500, &c., 512, &c., 674, 675, 686, 891½ *k*, 893 *a*, *c*, *e*, 896, 900, 902 *g*, 904 *bb*, 905, 905¾, 1088.

836. The *ninth* ground of induction goes back to ancestral diseases; and assumes their transmission, by hereditary impurities of the blood, to succeeding generations. I have referred sufficiently to the philosophy of this subject in the present work (§ 75–80, 143–147, 220, 327–331, 559, 561–563, 591, 659, 666 *b*, 674), and more extensively, and in other aspects, in the *Commentaries* (vol. i., p. 464, &c.). I shall not, therefore, again encounter this part of the foundation; but cannot refrain from adverting to its pernicious effects in practice. One of its vague attendants is the doctrine of "poverty of the blood," and this, as practically applied to active conditions of scrofula, is a fearful scourge to the human family. The "enriching black meats," and the "sustaining cordials," which are every where commended to the subjects of phthisis, in its early stages, are the occasion of a greater mortality in one day than ever proceeded from the abstraction of blood in all diseases since medicine became an art (§ 620, *note.* Also, *Comm.*, vol. ii., p. 608–634, "*Pathology of Tubercle and Scrofula*").*

837, *a.* Humoralism assumes, as its *tenth* fundamental basis which I have indicated, that remedial agents when injected into the circulation sometimes produce the same effects upon particular organs as when administered by the stomach (§ 823).

Rarely has this experiment been tried on man, in recent times; probably in consequence of the mere transfusion of blood having been fatal, and interdicted by law, in former times. It is almost entirely limited to animals; when, as might be expected, the agents exert their effects mostly upon the venous system; "giving rise to *scurvy, yellow fever, typhoid fever*, &c., not to mention a number of *other affections which I called into being before you*" (§ 744, 709, 810).

The case in which Dr. Hale, of Boston, injected castor oil into his own circulation is a standing reference; but loses force from want of confirmation. What though, however, it rewarded the gentleman with a few moderate evacuations, I have never yet seen it affirmed by

* See NOTES F p. 1114, MM p. 1141.

the advocates of operation by absorption that castor oil has been detected within the organism after its exhibition by the stomach; and we need not doubt that the experiment has been satisfactorily tried.

837, *b*. That certain articles of the materia medica which manifest specific relations to particular parts when administered by the stomach will exert specific effects according to those relations when injected into the circulation is clearly inferable from the first principles in physiology. If vomiting result from the mere action of tartarized antimony upon the mucous surface of the stomach, and purging from that of castor oil on the intestine, it should probably follow that the same results will happen when either of these, or analogous agents, are injected into the veins, and are circulating within the very organization of parts possessing superficially those relations to the same agents (§ 150). Each series of observations, however, stands independently by itself. The injections prove nothing beyond their own results. They can have no bearing upon the question of superficial action; and we may as well deny that croton oil, hellebore, elaterium, &c., act upon the skin when they produce inflammation of that organ as to deny the same local action upon the intestines when they increase their motion, augment their secretion, or inflict inflammation upon them; we may as well deny, I say, that we feel with the ends of our fingers, or assume that offensive odors, tickling the throat, warm water, and mental emotions, produce vomiting through the medium of the circulation. Humoralism must group the whole under one category, and must include all those varying susceptibilities which arise from habits and analogous causes as exerting their morbific effects upon the blood; for the moment it regards the solids as taking an initiatory step it opens a door for its own expulsion (§ 651 *b*, 827 *e*, 1088 *d*).

837, *c*. A great variety of examples might be adduced in proof of the repugnance of nature to the doctrine of humoral absorption as commended to our confidence by the experimentalist, and which equally confirm the vital theories of morbific and remedial action, whether the agents be applied to the mucous tissue or to the skin. What, for example, would be the condition of the acetate of lead, or the nitrate of silver, or sulphuric acid, were they absorbed from the stomach? Utterly changed, perfectly inert, on their contact with the blood. How, then, does sulphuric acid, or the acetate of lead, arrest the night-sweats of phthisical subjects? What disposition, I say, will you make of the universal effects of certain familiar substances applied to the skin; as the numerous preparations of mercury? How will you account for the well-known action of nitric acid upon the liver, when applied in the form of *pediluvium?* Interrogate the chemist as to the condition of all these things, and many other analogous remedial agents, when he mingles them with the blood (§ 1088)

The experiments, therefore, have no tendency to prove the doctrine of absorption. On the contrary, they go to substantiate what I have said of the nervous power as the immediate cause of the remote effects, and the importance of duly considering the special modification of the properties of life in the different tissues and organs (§ 133-152, 227, &c.).—NOTE R p. 1123.

837, *cc*. But, after all, the foregoing experiments are worthless in a practical sense, since they have been made (unless in rare and unsuccessful instances) upon a very few individuals in health; and there-

fore prove nothing as to their action upon diseased conditions (§ 137, 143, 149, 150, 152 *b*, 156, 163, &c.). And, coming to the multifarious examples in which animals have been the subjects, they serve only to raise our astonishment that educated men can have imagined their applicability, in any sense whatever, to the profound problems of human maladies. The difference in constitution alone is conclusive against the supposed analogies. It is conclusive, indeed, against all such reasoning from one species of animal to another species, however apparently allied; since, in respect to the critical relations even of food, there is scarcely any certainty attending this inductive process, while the distinction in respect to the influences of morbific and remedial agents upon different animals is marked by every agent which is capable of making any positive demonstration. Some vegetable poisons, indeed, which are most destructive to man, and to many species of animals, are to others of the brute tribe wholesome articles of food (§ 18, 150, 191, 366, 447, 854 *bb*).

838. The natural adaptation of the various fluids of the body to the several parts with which they come in contact, and the certainty with which most of them produce disease in parts to which they are not naturally related, is conclusive that the blood cannot be medicated by any agents of sufficient power to act upon parts that are morbidly irritable, without often endangering every part of the body. The principle is of course the same as with the truly morbific agents; and, to be fully comprehended, the following references should be consulted (§ 133, 136, 137, 233¾, 277, 494, 526, 826 *cc*, 829, 847 *a*, 889).

839. As with morbific, so with remedial agents. The philosophy is essentially the same (§ 151). May we not, therefore, take from Nature an important hint as to the mode in which remedies operate, and apply it analogically to the modus operandi of morbific causes? Does unaided Nature medicate the blood? Does she ever effect a change in that fluid without an antecedent change in the solids? Never. Does she not always restore the blood from its morbid states through the agency of the solids alone? How is it with small-pox, and measles, and other self-limited diseases? Art can do nothing to shorten their established time, or affect their regular progress. Nature accomplishes the whole. But I say, again, does she first renovate the blood (§ 858, 861)? We may imagine primary changes in this fluid as the cause of the morbid changes which befall the solids; but if this were true, then, *ex necessitate rei*, the restorative powers must commence and advance with the blood. In the natural cure, however, there is no agent excepting the solids to exert the slightest impression upon that substance; by which I thus demonstrate the dependence of the morbid changes of the blood upon those solids by which their subsequent removal is brought about.

840. Try the question by an infallible experiment. Apply the medicine to the organ affected; tartarized antimony, for example, to the brain in phrenitis, to the lungs in pneumonia. How absurd the proposition! Even in the primary action of remedies upon the stomach, and when disease of that organ yields to their operation, it is not alone from the direct action of the agents, but greatly so from influences of the nervous power reflected upon the mucous tissue of the organ (§ 514 *b*, 516 *d*, nos. 6, 12, 657, 658).

Circulating within the organization, remedial agents of an irritating

nature exasperate disease far more certainly and violently than do cathartics when acting upon a highly-inflamed intestinal mucous membrane. This will be readily appreciated by all who have witnessed the stimulant effects of muriate of soda when injected into the veins of the dying subject of the cholera asphyxia. Simple as the substance, the scarce audible heart bounded under its influence beyond its natural vigor, and the whole vascular system instantly emerged from its sunken state into one of preternatural excitement, and long after the most powerful stimulants administered by the stomach would not awaken, in the least, the expiring sympathies of the heart, nor violent irritants applied to the skin rouse its circulation (§ 829).

Can it be entertained that pneumonia, or ophthalmia, or erysipelas, or furunculus, &c., are relieved by the transmission of the various substances, which may yield relief, to the very organization of the parts affected? And when vesication, and bloodletting, and mental emotions, are added to those, a medley is presented which defies assumption, but which is interpreted with consistency through the agency of the nervous power (§ 222–233¾, 686 *b*, 872, 904 *bb*, 905).

841. In former sections I had occasion to illustrate the law of vital habit by certain effects of morbific and remedial agents; and what is there considered would appear to cover the whole ground of solidism and vitalism. Among the many illustrations is the complex example of the influences of tartarized antimony (§ 549–554, 556), which may now be continued with a more specific reference to the humoral pathology, as it will be in a future section to that of its modus operandi (§ 902, 904 *bb*). But now, as hereafter, I shall show its operation through reflex action of the nervous system (§ 904 *bb*).

I may say, then, that it is especially to my present purpose that the humoralist, as well as the solidist, is guided, in his repeated administration of the antimonial alterative, by its effects upon the stomach; since nothing can be more obvious to either than that all the remote effects depend upon the amount of impression which the remedy produces upon the stomach. It is not, therefore, quantity, but effect, gastric effect, which is regarded in the administration of this distinguished humoral agent (§ 826, *c*). The intense excitement of fever, or the violence of pneumonia, yields to the first nauseating dose of the antimonial, or if it only approximate that point of gastric irritation. The next, and the next, in unaltered doses, may fail of an equal ascendancy, while the fourth makes no resistance to the returning phenomena. But, if there be now added to the original twentieth or eighth of a grain only a fiftieth or thirtieth part, the phenomena are again subdued the moment that gastric influence begins. And in this way may we proceed, experimentally, by continuing the same, or increasing the dose, and find at each repetition that the general results will conform to the impression which is made upon the stomach, at its nearest approximation to a state of nausea; whatever the requisite dose,—however small, or however large (§ 556, 873, 904 *bb*).

Again, antimonials are more salutary when they can be borne in gradually-increased doses than where it is necessary to lessen a small dose from the beginning. The reason is this. In the first, or most advantageous case, the irritability of the stomach is not morbidly susceptible to the action of the remedy, but, on the contrary, obeys the law of vital habit in its diminishing influences upon the suscepti

bility of the vital states (§ 551, &c.), so that the stomach is not injuriously irritated; while, in the opposite case, the law of habit has its exactly opposite effect (§ 556), and the susceptibility of the stomach being morbidly great, and farther aggravated by the antimony, disease of this organ is more or less liable to set in as a consequence, and the object of the remedy to be thus defeated. In the mean time, it may be shedding abroad pernicious reflex nervous influences in doses of extreme minuteness. In a general sense, the best dose is just short of that which produces nausea; but, at other times, occasional nausea may be very salutary, and again, at others, a full emetic dose may overthrow, at once, a formidable condition of disease (§ 476½ *h*).

The principle, though not the details, is universal. Its practical application is of the highest importance, and, unlike the hypothesis of absorption, may be in the hands of all (§ 481, 494, 828 *b*, 1088).

842. The *eleventh* foundation of humoralism, and the last in the order of arrangement (§ 823), is derived from the tan-yard. Thus,—animal tissues have their strength increased by immersion in astringent vegetable infusions; therefore, as many tonics are also astringent, they are taken into the circulation and give strength to the stomach and the system at large by the same process (§ 569 *b*, 904 *d*).

So much has been said upon the foregoing philosophy in the course of this work, that I should have avoided the present subject but for its incorporation into the basis of humoralism, and as I was desirous of presenting the whole system in a methodical manner.

My own construction of the modus operandi of astringents is briefly set forth in my Arrangement of the Materia Medica, and will be extended in subsequent sections of the present work. But I would now propound for the consideration of the humoralist the modus operandi of *cold*, of *ipecacuanha*, of *muriate of soda*, and analogous agents devoid of true astringency, in arresting hemorrhage; or how vesicants and ipecacuanha often relieve redundant effusions from the pulmonary and intestinal mucous membrane, or how opium restrains all secretions (§ 890 *b*)? The force of necessity which applies to the answers will be very likely to extend its sway throughout the classes of astringents and tonics, and yield to the laws of reflex nervous action.—Note Bbb p. 1148.

843. That nothing may be omitted which may serve to complete my analysis of humoralism, I may state what may be regarded by many as a *twelfth* fundamental ground; though it is only an induction from the general assumption that the blood is radically vitiated, &c., and the efficient cause of the morbid state of the solids. Its "black" color, as it is called, which appears in congestive fevers, scurvy, &c., is taken as one of the important evidences of its corrupted state; and when it refuses to coagulate, humoralism assumes that "putridity" has taken place. It will be thus seen that "putrescency" is only a corollary of the seventh proposition in my analysis, and sustained by the *fifth* (§ 823, 834). Liebig has gone scientifically into the subject (§ 350); and in the *Commentaries* I have endeavored to do justice to its merits (vol. i., p. 403–410, 418, 430–440, 442–460, 663–673). But, what is more remarkable than the rest, it is argued, that, because the blood ultimately becomes "black" or "putrid," it therefore takes the initiatory step in the morbid processes. It is also an important "fact" in the "experimental philosophy" of humoralism, that the color of this blood is changed to a vermilion hue by adding saline cathartics to

that which is abstracted; from which the conclusion is drawn that the same substances are taken into the circulation when administered by the stomach, and that they then and there change the color of the blood in like manner; which proves that the remedial effect is exerted upon that fluid. There is no doctrine in humoralism more strenuously maintained, and none in which the conclusions are considered more logical. It goes with the rest in representing the nature of the "experimental philosophy" which now lies at the basis of theoretical and practical medicine. Next to this are *anæmia*, *chlorosis* and *iron*.*

844. Finally, an author of the olden times, writing in the palmiest days of humoralism, but not of the professional corps, in one of his sallies upon the vagaries of philosophy, let slip a bolt which demolishes every material fabric in medicine.

"All the world knows," he says, "there is no virtue in charms; but a strong conceit and opinion alone, which forceth the humors (*moral* ones), spirits, and blood, which takes away the cause of the malady from the parts affected. The like we may say of our magical effects, superstitious cures, such as are done by mountebanks and wizzards (§ 167 *f*, *note*). An empiric oftentimes, and a silly chirurgeon, doeth more strange cures than a rational physician. Nymannus gives a reason: because the patient puts his confidence in him, which Avicenna prefers before art, and all remedies whatsoever. 'Tis opinion alone, saith Cardan, that makes or mars physicians; and he doeth the best cures, according to Hippocrates, in whom most trust. So diversely doth this phantasie of ours affect, turn, and wind, so imperiously command our bodies, which, as another Proteus, or a chameleon, can take all shapes, and is of such force, as Facius adds, that it can work upon others as well as ourselves. How can otherwise bleareyes in one man cause the like affection in another? How does one man's yawning make another yawn?—one man's p—ing provoke a second many times to p? Why does scraping of trenchers offend a third, or hacking of files? Why do witches and old women fascinate and bewitch children, but, as Wierus, Paracelsus, Cardan, Mizaldus, Valleriola, Vannius, Campanella, and many philosophers *think*, the forcible imagination of the one party nerves and alters the spirits of the other? Nay, more, they can cause and cure not only diseases, maladies, and several infirmities, by this means, as Avicenna supposeth, in parties remote, but move bodies from their places, cause thunder, lightning, tempests; which opinion Alkiadus, Paracelsus, and some others approve of; so that I may certainly conclude, this strong conceit or imagination is *astrum hominis*, and the rudder of this our ship, which reason should steer, but overborne by phantasie, cannot manage, and so suffers itself and this whole vessel of ours to be overruled, and often overturned" (§ 167 *f*, *note*, 227, 234 *e*, 500 *f*, *o*, 509, 892¾, 1072). What a display is here of our *direct* nervous action!

845. Having now considered the grounds upon which the humoral pathology reposes, and how estranged from the institutions of organic nature, I shall proceed to offer the reader a condensed view of my argument predicated alone of the fundamental laws of physiology.

I propose showing by this argument, that the blood is neither a *primary* cause of disease in the solids, in virtue of its own morbid condition, nor an *aggravating* cause of disease when altered in its character by the morbid action of the solids.

* See Note R p. 1123.

846. No one will deny what is affirmed by Andral, that every morbid change in the action of the solids is probably followed by some change in the blood. The influences from bloodletting often give rise to very remarkable and instantaneous changes in the circulating mass (§ 952, *a–h*).—*See* KRIEMER's expriments § 485.

I also agree with Andral, that any *primary* alteration of the blood, of a morbid nature, must, with greater certainty, produce disease of the solids (§ 827, *e*).

The latter proposition is the basis of humoralism, and it is this which I now address.

847, *a*. There is a specious parallelism about the two foregoing propositions, of which humoralism has taken no little advantage. Both are conceded by the solidists, and humoralism draws its conclusions from both, just as has been seen of its principal data (§ 823, &c.). Its inferences involve the assumption that the blood and the solids sustain, reciprocally, the same relations to each other; when, in truth, the distinction is nearly as great as between an agent and the object acted upon. There is this difference, however. In the present case, in their natural state, the blood is the object, while it contributes to the support of the agent, and to maintain its action.

Were the blood, therefore, to become primarily diseased, it would then assume the same relation to the solids as any other morbific cause, and this the more so on account of its incorporation with them.

Now, observe the humoral premises, as laid down by Andral, and considered impregnable by all humoralists. It will be seen that the first is the very thing which is most denied in humoralism,—the ground of solidism itself; yet is it put forth for an unreflecting world. Thus:

1st. Every morbid change in the action of the solids is followed by some change in the blood.

2d. Every *primary* alteration of the blood, of a morbid nature, produces disease of the solids (§ 846).

Therefore, say Andral, and other humoralists, every morbid change in the action of the solids is occasioned by a primary change in the blood. That is the logic (§ 843). But, we have seen that the two propositions are not convertible in a physiological sense, while they stand as independent statements, and in exact opposition to each other.

But let us reverse the logic, and then see how the case will stand. By the first of the premises, the solidist argues that all morbid lesions of the blood are dependent on primary changes of the solids. And this conclusion is justified by the strongest force of analogy. From the germ to the adult, all the results of organic life have their origin in organic actions. The nutritive fluid itself, from the time that organic actions begin, is universally conceded to be either directly or indirectly the product of these actions; and the only sense in which the blood can be regarded as an agent, is that of stimulating the solids so that they shall carry on the work of life and appropriate the blood to their own uses (§ 1087).

Here, then, we must steadily regard the true relation of one to the other, in the farther progress of this inquiry.

Now, it is said that the solids, which give being and vitality to the blood, become, in their normal state, the subject of its morbific action; and, according to the premises of humoralists and solidists, when the solids are diseased, the blood undergoes disease in consequence.

If, therefore, diseased blood be *originally* the cause of disease in the solids, it must certainly maintain an ascendency over them. Moreover, the solids, in their turn, react upon the blood and increase the diseased state of that fluid, or the *primary* morbific cause; and, according to the admitted premises, *every increasing degree of disease in the blood must be a cause of increasing disease in the solids.* Thus would the blood and solids perpetually act and react upon each other; and since a morbid state of the blood, according to humoralism, is the primary cause of disease in the solids, and constantly becomes more and more diseased and morbific in virtue of the morbid state which it sets up in the solids, it is plain, if the doctrine of humoralism were true, there could *never be a recovery from disease.*—NOTE AAA p. 1146.

It follows, therefore, I say, that the solids having been brought into a morbid condition by their own natural stimulus, and their own means of sustenance, and the morbific state of the blood continually advancing, according to the admitted premises, every disease so beginning must necessarily terminate in death. For, again, in the first place, I have shown the absurdity of attempting the restoration of the blood to its natural state by any direct action upon it by foreign agents; and secondly, what I have thus shown an absurdity is a matter of universal admission, since it is conceded by all that the natural state of the blood is entirely dependent on a natural or healthy state of the solids. Nor can Nature, in her spontaneous cures, begin to restore the blood but through a primary recuperative act on the part of the solids. NOTHING, THEREFORE, CAN MAKE HEALTHY BLOOD BUT THE HEALTHY ACTION OF THE SOLIDS. It is exactly with morbid blood as with morbid bile, mucus, &c. The restoration of one depends as much as the other upon an antecedent improvement of the solids. No humoralist medicates the blood to change the bile or mucus, *per se.*

847, *b.* As the foregoing doctrine is based upon fundamental laws in physiology, which admit of no "exception" (§ 284–288), it is manifest that, when the constitution of the blood is altered, or becomes diseased, in virtue of a diseased state of the solids, the blood *thus altered* is not an *aggravating* cause of disease in the solids. Indeed, should it become, under these circumstances, a direct morbific agent to the solids, the same philosophy would hold, the same effect obtain, as were the blood primarily diseased; since, as the blood is entirely dependent upon the solids for its healthy constitution, the moment it becomes a morbific agent to the solids, the latter will have lost a control which they can never regain.

847, *c.* The fundamental principles now stated might have been inferred from the final cause of the blood; since it would have been a radical defect in the animal economy, that a fluid which pervades so universally every part, which is intended for the growth and nutrition of the whole, which depends upon those parts for its being, and those, in their turn, upon the blood for their nutrition, and is at all times in subordination to the state of the solids in the natural condition, should receive a morbid impress from a part or the whole, which would not only defeat its great final purpose, but give to it an ascendency over those powers and actions to which it is entirely submissive, for the great end of life, in their natural state (§ 43, 277, 278, 303¼, 303½, 322–326, 385, 409 *f–i*, 411, 422, 424, 449 *a*, 464, 638, 733 *d*).

There is an ever-varying adaptation of the state of the blood to

the varying condition of the solids, and this is brought about by the solids themselves. It proceeds, in equal pace, with the changes of the latter; as clearly and forcibly exemplified during the operation of general bloodletting (§ 136, 970 *c*). The properties and universal condition of the blood, therefore, undergo changes corresponding with any alterations of the vital condition of the solids. What is physiologically true in this respect must be equally so in a pathological sense (§ 639, *a*). A morbid state of the blood is an exact product of an antecedent change in the solids, by which they move on in harmony (§ 653, 733 *d*, 740, 741).

847, *d*. Just so is it with the morbid product of an ulcerated surface. The exact condition of the product will depend upon the exact state of the solids by which it is generated (§ 653), nor does the product, however morbid, increase the diseased state of the solids, unless it undergo some chemical change after its elaboration. Were it otherwise, the natural and immediate result would be a perpetual increase of the morbid condition of the ulcer and of its secreted product. The same, again, is exactly true of the blood and the organs upon which it depends (§ 133 *c*, 136, 137, 150–152, 740, 741).

The analogy of which I am now speaking is still more forcible in its connections with the humoral philosophy of morbid blood, when it is considered that, with whatever violence morbid secretions may act upon sound parts, they bear a common relation to all other morbific causes, and that, therefore, as soon as the parts are brought into a morbid state and generate other or the same morbid products themselves, they cease to be offended by either. The surface upon which the syphilitic virus, or that of small-pox, excites suppurative inflammation, ceases to be offended by the virus as soon as it becomes the product of the part. Now it is, indeed, that not only is this resistance made, but Nature may set in with her recuperative process.

It is hardly necessary to add, that there is no physiological coincidence between the foregoing morbific causes and morbific blood in the humoral acceptation. The blood, in the humoral pathology, is converted into a morbific cause by agents foreign to the organic properties and actions. These properties and actions, I say, therefore, will have lost their control over the blood thus affected, since the blood is their natural stimulus, the *pabulum vitæ*, and depends upon a healthy state of the solids for its integrity.

847, *e*. The correspondence of which I have now spoken between the modified vital properties of a part and its morbid products, and between a diseased state of the solids and blood rendered morbid thereby, has its deep foundation in physiological laws. The principle is seen, naturally, in the adaptation of the veins to venous blood, the ureters and bladder to the urine, of the gall-bladder and mucous tract of the bowels to the bile, while venous blood is fatal in the arterial system, and these natural products excite inflammation in other parts (§ 133, &c., 385, 733 *d*). Mark, however, that such inflammation cannot be overcome while a fresh supply of urine or bile is brought into contact with the parts which they had thus offended. It is not now, as was just seen of the syphilitic and small-pox virus (§ 847, *d*), since no part is capable of having its constitution so altered as to generate urine or bile, and therefore there can be no preternatural adaptation of the vital state of any part to the morbific properties of those natural secretions.

And just so with the ordinary forms of disease, if excited in the solids by a primary diseased state of the blood. There will be nothing, then, to make healthy blood, and disease must go on to the death. The humoralist seems to have had some vague conception of this, since he applies himself to drugging the blood.

847 *f*. Again, as to the morbid secretions and the blood, in the former case the general powers of the body may contribute their restorative influence (§ 848), but not in the latter, according to *humoralism*. But, in the sense of *solidism*, if the alterations of the blood depend on an antecedent morbid state of the solids the changes of the blood will be always suited to the existing condition of the organic properties and actions, of which the morbid state of the blood has been only a consequence, as in the foregoing analogous cases (§ 847 *e*). And since the changes are thus exerted, the same organic properties and actions, whatever their condition, can, either unassisted or by the aid of remedies, replace, by their own improvement, the morbid changes of the blood by others of any degree of approximation to the healthy standard; as was seen of a part in relation to the syphilitic or small-pox virus.

847, *g*. Is it asked why the blood, when essentially altered by any local inflammation, is not, according to my principles, detrimental to the system at large? The solidist can reply upon sound physiological laws, while the humoralist can make no answer.

I say, then, that all other parts are now modified in their powers and functions by reflex nervous influences of the local disease (§ 222, &c., 452, &c., 500, &c., 512, &c., 733 *d*, 811). In proportion as that affection is capable of modifying the blood, so does it exert a reflex nervous action upon all parts of the organization (§ 674, *d*). The modifications of the blood and the constitutional derangement being produced by a common cause, the blood and the solids are universally adapted to each other; the blood being thus inoffensive to the general organization, just as the virus of the small-pox is harmless to the skin by which it is generated (§ 858).

This law of adaptation meets us every where, both in the natural and morbid states of the animal kingdom. It is the same great work of Design under all the circumstances of life. In disease it is coincident with what is seen in health of the modified irritability of the larynx, adapting it to atmospheric air, of the pylorus to chyme, &c. The same as the adaptation of natural bile to the natural state of the intestine, or of morbid, acrid bile to the diseased or disordered intestine. It is analogous to the expedient by which a deep-seated abscess reaches the surface, and, finally, to all the processes of recuperation (§ 156 *b*, 733 *d*, *references*). Through the same law of adaptation, also, the solids are brought into such relationship with each other by the reciprocal influences of disease as it may affect various parts, and whatever the variety in the coexisting conditions, that a single remedy, as bloodletting, a cathartic, an emetic, &c., may be universally suited to the several pathological states. These cases are perpetually before us; and were not my philosophy true, all our efficient remedies would forever aggravate some part of a compound disease. The principle is the same in both the cases, and our experimental knowledge of its truth in the latter confirms what I have stated as to the blood in the former (§ 143, *c*).

847, *h*. Were not the foregoing all-wise provisions established in

the constitution of animals, all the diseases which it may now throw off would require for their removal the interposition of Supernatural Power (§ 133 *c*, 151, 152). The morbific blood would not develop disease in one part alone, as overlooked by the humoralists, but throughout the universal organism; and the blood itself, becoming progressively diseased in the ratio of its morbific influence upon the solids, would hasten the general catastrophe in an increasing ratio. The blood of the victim of small-pox would poison more and more profoundly, while the purulent matter would erode the body and lend its powerful aid in the universal work of destruction. Nature, however, comes out triumphantly, and in an allotted time. We must look to the philosophy which I have taught for the only possible interpretation; while it opens a door to a stupendous, harmonious system of fundamental laws (§ 233¾, 500 *k*, *m*, 841, 893 *a*, *n*, 904 *bb*, 905).

848. It will now be apparent from what has been said in the preceding section, how it is that remedial agents will call into salutary reflex nervous actions various parts of the body not affected by disease, but whose susceptibilities are increased by morbific reflex nervous actions excited by absolute desease, and upon which parts the remedial agents might otherwise be inoperative. In this way, therefore, various parts may be rendered instrumental in establishing those influences upon the seat of disease which enables Nature to take on the recuperative process (§ 137 *d*, *e*, 143 *c*, 149–151, 152 *b*, 163, 514 *h*, 674 *d*). Whatever, too, may be the complexities of disease, the right remedy will be at least compatible with the whole condition (§ 870 *aa*, 891 *g*, 891½ *e*, *f*, 892 *c*, *d*, 892¼ *c*, *d*).

849. Upon the foregoing fundamental ground (§ 847), it appears, *a fortiori*, that if perfectly healthy human blood be allowed to flow into the veins of a subject affected with fever, or scurvy, or inflammation of any important organ, in quantities sufficient to produce an effect, while, also, a corresponding quantity of morbid blood flows out of the veins, such healthy blood would aggravate the disease (§ 136, 137 *b*, *c*, *e*, 149, 152). This induction from principles has been practically demonstrated, even to the death of human subjects, although the quantity of healthy blood transmitted was small. There was no natural relation between the healthy blood and the diseased solids, and the former, therefore, became morbific (§ 152, *b*).

850. It follows, also, from the foregoing physiological principles, that morbid blood may excite disease in a healthy subject, if transferred in certain quantities into the circulation. It may be necessary, however, that the quantity should be large; when, as soon as morbid action follows, the whole mass of blood will become affected, and thus brought into harmonious relation with the diseased state of the solids (§ 847, *e–g*). Hence, the great mass of blood is altered from its natural state by the solids, and convalescence may, therefore, begin spontaneously, or through the intervention of art.

It is scarcely necessary to add, that the present case is entirely different from those in which it is assumed by the humoralists that the whole mass of blood is primarily morbific. The injected portion is like any other morbific agent circulating with the blood; nor does it assimilate to itself, any more than wine, or bile, when so injected, the circulating mass. The general mass remains under the control of the solids, and receives from them its deterioration should disease ensue.

Nor doss it follow that the injected blood will produce the same condition of disease as that by which it was altered (§ 350, nos. 44, 45, 97, 744, 810), or be fatal either in this or the other case (§ 849).

851, *a*. Finally, the humoral pathology chains the mind in ignorance, and whether with the learned man, or the bolder empyric, leads equally, in its application, to the most unhappy practical errors. The violent assumption is equally made by either, that the blood must be purified or otherwise changed by the direct action of remedial agents; that its impurities must be purged away; that the means are taken into the circulation, even calomel, blue pill, and other less soluble substances; that they are then conveyed into the torrent of the circulation, cleanse, neutralize, purify the blood, and reinstate its natural condition, as necessary to the subsidence of disease in the solids. It is all the work of the *blood-making faculty* of calomel, opium, and nux vomica. The treatment, therefore, is apt to be governed by this indication (§ 1087).

Or, does the humoralist resort to bloodletting; he professes to carry off the poison, the "peccant humors," &c., by abstracting some dozen ounces of blood from the circulating mass. But this is neither conformable with fact, nor with the hypothesis; since the great bulk of the poison remains behind, and since, also, at the beginning of the disease, the infected mass must be greatly less morbific than when remedies are applied at its advanced stages. The humoralist affirms, indeed, that an inappreciable quantity of miasma, or of the virus of the dissection wound, &c., enters the circulation and throws the whole mass into a ferment, and that this goes on progressively increasing; nay, that one drop of blood thus affected is sufficient to contaminate the whole mass, "as a little leaven leaveneth the whole lump," or "as one spoiled herring will taint the whole cask" (§ 350, nos. 44, 45, 821 *c*). And yet may a severe grade of disease be suddenly overcome by a single bloodletting, or by a cathartic, or by an emetic, or by a full dose of quinine (§ 284, 330, 892 *b*, 900, 902, 905 *a*, 970 *c*).

But the humoralist, learned or unlearned, is little prone to abstractions of blood in recent times, and now, more than ever, proceeds upon the broad basis of his pathology. Cathartics are his special favorites, for they purge off the humors, and cleanse the blood; or if it be quinia for an intermittent, it is administered with a view to neutralize a poison. To him the *vis medicatrix Naturæ* is like the midnight darkness to a blind man (§ 240, 839, 853).

851, *b*. How different the practice of the solidist; how enlarged his philosophy; how various his remedies; how consistent his doctrines; how important to humanity! Let a single example illustrate and confirm his theories. According to the nature of the predisposing causes, and the exact pathological conditions, he cures ophthalmia by an emetic, or cathartic, or by bark, or arsenic, or iodine, or mercury, or bloodletting, or leeches, or blisters, or electricity, or local sedatives or stimulants, and by light or darkness (§ 675, 686, 904 *a*).

851, *c*. I regret the necessity of the parallel and the contrast. But I speak of facts and philosophy; nor should I be true to my duty did I not speak with honesty and frankness. If wrong, refutation will be easy and gladly accepted (§ 1 *a*).

THERAPEUTICS.

852, *a.* THERAPEUTICS is the great ultimate object of all medical inquiries. It refers back to the natural physiological states of the body, and to the laws which govern organic beings in their healthy condition. It takes in the whole range of pathology, since there could be no rational treatment of disease without a previous investigation of its causes and nature, and a proper knowledge of their relative laws and principles. Having, also, for its specific objects the means of cure, and their just application to disease, therapeutics comprehends all the vital relations of the *Materia Medica.*

Notwithstanding, however, the vast range of principles which it embraces, and the immensity and complexity of its details, it has, essentially, but one fundamental object; namely, that of inducing such changes in the morbid organic properties and functions as will enable them to return spontaneously to their natural state (§ 177).

852, *b.* We thus find that all parts of our inquiry are intimately bound together; that together they form a perfectly consistent whole; and that as a whole each part is necessary to all the rest (§ 137 *a*, 639 *a*).

Wonderful, indeed, that so vast a subject should be so simple in its elementary principle; but more wonderful still that a principle so simple should be more complex in its attributes than all other principles in nature (§ 133–153, 177–182, 222–233).

853. It is an attribute of the properties of the Vital Principle that they possess an inherent tendency to return from their morbid to their natural states. This endowment has given rise to Therapeutics, and is indispensable to the perpetuation of organic beings. It belongs, therefore, to plants as well as to animals (§ 133 *c*, 185). The object of art, in the treatment of disease, is to place those properties in a condition which will enable them most readily to obey this natural tendency (§ 189). This is what I mean by *Nature*, and the *vis medicatrix*.

854, *a.* Remedial agents operate upon the same principle as the remote causes of disease (§ 150–152). They can never transmute the morbid into healthy conditions. That is alone the work of Nature (§ 524, *d*, 862). Art can only make the best use of her laws (§ 237).

854, *b.* The most violent poisons are among our best remedies. "*Ubi virus, ibi virtus.*" In a medical sense, however, we do not know them as poisons, but as among the choicest blessings bestowed upon man. Poisons, however, they may all become when not employed in their proper relations to disease (§ 150, 673, 674). That it may be properly known in what respects they are remedial, they should be studied in their morbific aspects; studied in their morbific effects upon diseased, not upon healthy, conditions (§ 137, *d*, &c.). Thus, also, shall we employ them with a more solemn reference to their morbific capabilities, and under the deep conviction that when injudiciously administered they cannot fail to exasperate disease.

854, *bb.* The foregoing consideration demonstrates an important fallacy at the very foundation of homœopathy. It affects very seriously its main principle as founded upon experiments with remedial

agents upon the healthy subject. But the fact that this objection has not been advanced is an evidence of the little consideration which is bestowed upon the vast differences between the operation of remedies upon healthy and diseased organs; and if such palpable distinctions be not observed, what must be the amount of knowledge in respect to the immense variety in the degrees and kinds of susceptibility in different forms of disease and in the variable pathological states of a common form (§ 137 *d*, 150, 191, &c., 892¼ *b*, 855, 856)? There is nothing, however, more important in medicine than the principle which I am now considering. But, there can be little hope of its general recognition till experiments upon animals with a view to elicit the causes and the philosophy of disease as manifested in the human race shall have been abandoned. Not till all indications as to the curative virtues of remedial agents shall become limited to observations upon man alone, and man in a state of disease. Not till all others shall have ceased. Not till principles in medicine are wrested from the hands of the chemical and mechanical philosophers (§ 676, *b*). Not till a proper decision can be obtained between the two methods of considering disease as propounded in sections 5½ *a*, 675, 686 *b*. Should the last of these references prevail, then must fall, as an indispensable prerequisite, all the principles and suggestions which have been derived from the philosophy which concerns the external world, and yield to that system which I have set forth as the foundation of the method of interrogating disease according to that section to which this special reference is made (§ 686, *b*, 1058 *b*, *note*, 1059).

854, *c*. In respect to the absolute influences of all remedial agents of positive virtues, they are essentially morbific in their remedial action; as will have been duly explained (§ 893, 902). They are alterative in disease, as in health, in respect to the vital properties and actions. There is no difference in principle as to their absolute action. In certain remedial quantities many may induce, in the healthy organism, various degrees of disease with as much certainty as those agents which are called morbific. It is upon this *alterative* nature of remedial agents that I have founded, in part, my *Therapeutical Arrangement of the Materia Medica* (§ 893, 897–901, 1059).

854, *d*. The difference, in effects, between the truly morbific and remedial agents is two-fold. Morbific causes make their deleterious impression, in a general sense, more profoundly and more permanently. Positive remedial agents, in certain quantities, exert such morbid changes as are not profound, and from which the properties of life may recover, by their inherent tendency, their normal state. But, there is also another difference which is fundamental. The two classes of agents not only affect the vital states in different modes, according to the special virtues of each, but each establishes changes according to the existing condition of the vital states (§ 137 *d*, 149, 150, 854 *bb*). The *Materia Medica* is necessarily founded upon the foregoing principles, however it may have been hitherto unexplained, or however it may not be now admitted (§ 2 *b*, 143*c*, 895, 902 *f*).

854, *e*. In the treatment of disease, therefore, we do but substitute one morbid action for another. Physiological processes do the rest.

854, *f*. In consequence of the laws of organization, the approximations of morbid conditions are such as to enable us to establish upon a certain combination of phenomena certain general principles of

treatment, corresponding harmoniously with the principles through which the morbific agents have induced the adverse changes. The curative principles, therefore, will be liable, in all cases which are not exactly alike, to certain modifications according to the modifications of disease; and these are to be learned, especially, from the vital manifestations (§ 150–152, 177–179, 182 *b*, 638, 650, 670, 672, 676, 677, 680, 733 *e–i*, 741 *b*, 745, 756 *b*, 758, 766, 854 *bb*).

855. Many of the remedies for disease, especially when Nature is engaged in the recuperative process, consist of the ordinary means of maintaining health, such as the various modes of exercise, change of climate, &c. These means now operate with greater power than under circumstances of health, and must therefore be carefully adapted to the existing state of the patient, since, when unduly applied, they aggravate or reproduce disease like agents of absolute virtues (§ 137 *b*, 143, 147, 149, 150, 854 *bb*, 872 *a*, 902 *m*). When productive of useful effects they co-operate in a direct manner with the tendency to restoration which had already begun (§ 672, 733 *e–i*).

Of the same nature, also, are the agreeable excitements of imagination, of society, of rural scenery, of joy, hope, amulets, charms, &c. While, also, some of these means may be powerfully morbific they may be equally curative of disease (§ 226, 227, &c., 844, 1067).

856, *a*. There are yet other remedial means which may be called negative, or such as merely allow Nature the fullest opportunity to go on with her recuperative efforts. They make no impression upon the vital conditions; and all the changes to which they administer grow exclusively out of the constitutional tendency of the properties and actions of life to return to a state of health; which is the import I give to the convenient term *Nature* when employed therapeutically.

856, *b*. Now the means of cure embraced in this and the preceding sections are of the highest moment in every case of disease; and yet are they the most neglected except by those who depend on Nature alone (§ 854, *bb*). In a large proportion of chronic forms of disease, and where they are acute but not profound, little else is needed than a modified system of hygiene adapted to the individual cases. Coming to graver modes of disease, and where active remedial agents are required, the negative means are more important than in the former cases, and nothing more so than a rigorously low diet.

Here, then, is opened a wide door for the contemplative and practical inquirer. Here recuperative nature is displayed according to the Ordination of Providence throughout brute creation. The animal sickens, "starves," and thus nature works the cure. Man alone violates her law (§ 239, 240).

857. It has been seen that morbific and remedial agents, even the natural agents of life, acting with certain intensities, and under given circumstances, may be entirely on a par; each leading with certainty to morbid changes which may transcend the restorative disposition of the organic functions.

This fact involves a principle which is fundamental in the Materia Medica; that of limiting the quantity of remedial agents, and the duration through which they operate, so that they shall only establish such changes in the vital conditions as will enable them to exert their fullest tendency to return to a state of health. Beyond that point positive remedies determine morbid changes that are embarrassing to

Nature, and may be far more so than the conditions which had been instituted by the primary cause of disease. This is a matter of constant demonstration; and if we connect with it the more general abuse of food, their common mode of action becomes so obvious, that he who may pause in his excessive medication should take the hint and unite the advantages of the negative treatment (§ 856).

I am now upon ground of the first importance in practical medicine. I have endeavored to enforce and to illustrate that importance by calling up, in a variety of shapes, those fundamental physiological laws which give the greatest determination to the effects of remedial agents, in respect to their amount, and the frequency of their repetition (§ 889, *l*). I leave out of consideration, for the moment, the vast questions which relate to the right adaptation of remedies as concerns their nature, and the order of their application (§ 150). I would dwell abstractedly upon the *dose* and the *frequency of its repetition.* Too little reference to the natural constitution of the properties of life and the laws which they obey in their natural states, and too little dependence upon recuperative nature—ay, I may safely affirm, too general an abandonment of that foundation, and even a universal ignorance of the practical bearings of some of its most important elements (§ 516 *d*, no. 6, 524 *d*), have mainly led to an abuse of remedies in respect to doses and their repetition which has been more pernicious than errors in their appropriate nature, and their order of application. That abuse, indeed, in connection with the stimulant and feeding practice, is the whole secret of the origin of homœopathy, and of its extensive prevalence (§ 621, *a*, 1068).

It must be conceded, however, that there is no attainment in medicine so difficult as that which relates to quantity or dose, or which requires so much critical observation of disease; and next to that is the time when the dose should be repeated, or varied, or some substitute made. The most delicate points are relative to dose and repetition, and these can never be attained with any accuracy without a full appreciation of certain physiological laws which I have endeavored to expound as far as my own apprehension of their nature will admit (§ 5½ *a*, 516 *d*, no. 6, &c., 686). It should be kept steadily in view that all efficient remedies are morbific in excessive doses, that what would be perfectly inert in one condition of the same disease may be fatal in another modification, and that the impressions produced are continued beyond the time of their direct operation, according to the nature of the remedy, its dose, the precise pathological conditions, &c. (§ 149, 150, 163, 191, 514 *g*, 516 *c*, 516 *d*, no. 6, 550, 552, 556 *b*, 558 *a*, 673). A repetition of the means before the influences already established shall have ceased, or have duly lessened, or have fallen short of the intended amount, either prolongs the cure, or exasperates and multiplies disease (§ 872).

858. The foregoing principle is strikingly shown, and a large reliance upon Nature as strongly enforced, by the impracticability of art in arresting the progress of the self-limited diseases, and by their spontaneous termination in health. We cannot, by any active treatment of small-pox, &c., place the morbid properties and functions in a more advantageous state to exert their recuperative principle than had been already done by the very causes of the disease. On the contrary, all active treatment embarrasses Nature, and is generally mor-

bific. Accidental conditions, such as inflammation of important organs, may spring up in the truly self-limited diseases, which may require a decisive impression from remedial agents; and it is an admirable law of nature that, in proportion as these special exigencies may arise, the influences of their pathological conditions will enable the more general affection to bear the treatment that may be demanded by the contingent derangements (§ 150, 156 *b*). But we must be careful to avoid such agents as may interfere with the established tendency of the general affection to subside spontaneously (§ 847 *g*).

Nowhere, however, is the recuperative tendency of nature, the *vis medicatrix naturæ*, so forcibly displayed as in the brute creation, where instinct alone obtains, and where organic life moves on unshackled by artificial habits (§ 856, *b*). All is the work of physiological processes.

859, *a*. We see, therefore, more and more, that, in therapeutics, we should cautiously avoid those fallacious inductions which have been drawn from the action of remedial agents upon man in health, and even upon animals and plants, and which constitute a part of the "experimental philosophy" of the age (§ 854). It is, however, one of the worst corruptions that has crept into medicine. I have variously indicated its want of philosophy, and the evils of its practical application. They are summarily comprehended in principles set forth in sections 149–152. These principles I regard as among the foremost in therapeutics; and here, but for other reasons, they would have been first announced.

859, *b*. To arrive at any just knowledge of the physiological relations of any remedy to a given form of disease, it must be considered in the opportuneness of its application, its appropriate degrees, and according to the varieties of constitution, age, habits, sex, &c., and according, also, to the nature of the affected organ, to the variations of any given disease, its reflex nervous influences, and as those influences may be modified by the remedy, and the connection of the particular remedy with other agents that may precede, or follow, or be simultaneously employed, and all other circumstances that may favor or embarrass its most salutary effects (§ 133–163, 535, &c., 574, &c., 585, &c., 622, 650, 651, 659–662, 671–673, 675, 685, 686, &c.).

859, *c*. Nevertheless, the salutary action of remedies, or rather the aid which they may contribute to the recuperative process, is commonly in the ratio of the intensity of disease. This grows out of the constitutional nature of the organic properties, as already variously considered, and *Medicine* simply administers their laws (§ 235, 237).

860. All remedial agents of positive virtues, like all morbific ones, alter the properties and actions of life, *cæteris paribus*, according to the nature of each agent (§ 652). Each one affects them in *kind*, and in a way more or less peculiar to itself. Hence, mainly, the varieties in any common genus of disease, as in inflammation and fever; hence, also, the modifications of a common mode of treatment, and hence the importance of selecting the cathartic, the emetic, &c., whose virtues may be most appropriate to the precise pathological condition of the case before us, and introduce the right pathological change.

861. There are but a few diseases which have a determinate tendency to a state of health, and these are, in consequence, denominated self-limited. Sooner or later, however, there is apt to arise in a large proportion of diseases a spontaneous subsidence This may not be

true of a great proportion of cases; but the restorative disposition is often manifested in a great number of instances of any given disease, while a greater number of the same disease may run on to a fatal termination. Their morbific causes are not such, as in small-pox, &c., as to establish modifications of the vital states which go on through regular changes till they terminate in health (§ 858); though there may be a strong tendency of this nature existing, as seen in intermittent fevers. New agents (called remedial, but in reality morbific (§ 901)) may, therefore, be made to operate so as to develop the restorative principle where it might otherwise fail, or introduce it sooner than it would occur spontaneously; and thus place the disease on a par with the self-limited, whose predisposing causes surpass all remedies, in a fundamental sense, in developing a tendency to the restorative process.

It is also important to consider that the restorative process, in a general sense, is most readily established near the invasion of disease, whatever its violence (§ 557 *a*, 868, 869, &c.).

862. Nature resorts to a variety of expedients in carrying out her process of cure. The principle is the same in all the cases, and its details illustrate what has been hitherto so obscurely meant by the *vis medicatrix*. It is the same, through all the intermediate conditions and complications, from those diseases which are marked by a definite order of results, as in the self-limited, to the most intractable maladies. A clear and impressive example of the nature of the principle is seen in the progress of an abscess toward the surface, to its termination in health (§ 733). Whenever inflammation passes its formative stage, there is always some sensible demonstration of the *modus operandi* of the *vis medicatrix*. These visible results are of a depletory nature, like redundancies of bile, and consist of lymph, serum, pus, &c.; and, although the results of salutary changes in the morbid states, and conducive to the farther subsidence of disease, they are apt to constitute as great or greater evils than the disease whose decline had led to their formation (§ 732 *d*, 733 *a*). It is the business of art to prevent these intangible consequences, although they grow out of a law by which Nature aims at preservation and cure (§ 733, *e*).

863, *a*. In the treatment of disease we endeavor to imitate Nature in her spontaneous efforts at relief, so far as principle is concerned. If these efforts result in the formation of new products, or an increase of the natural ones, in certain modes of disease, our remedies should be such, in the same, or analogous affections, as will be likely to determine an increase of the natural secretions (§ 732 *a*, *b*, 756 *b*, 785, 801, 805). And, although these effusions do not relate directly to the parts that may be mainly diseased (as is generally, though not always, true of Nature), they are significant that favorable impressions are made upon these parts. In the natural cure, also, it is these vital changes, far more than the physical products to which they give rise, that determine the cure. This is artificially exemplified in the influence of vesicants, rubefacients, issues, moxa, &c., upon deep-seated inflammations, and proving my doctrine of reflex nervous action.

863, *b*. Nevertheless, these redundant products, whether of Nature or of art, contribute more or less, as means of depletion, to the restorative process. The part, however, which they perform will depend upon a variety of circumstances, upon the nature and seat of the

disease, upon the means employed by art, upon the organ from which the effusion takes place, and whether from that which is diseased or from another which may only sustain a moderate sympathetic derangement, upon the nature of the product, and whether it be the consequence of disease or induced artificially.

863, *c*. If Nature institute the effusion, it is commonly far more curative than when flowing from remedial agents. The latter operate mostly by changing the morbid states; and although they are designed to imitate nature in their general results, they may be yet intended to prevent many of the consequences of spontaneous cure, such as effusions of lymph, serum, and blood, and the formation of pus. But, in accomplishing this, they institute an increase of those natural products which issue upon open surfaces (§ 862).

863, *d*. The increased product is most curative when it proceeds directly from the affected organ. This is true both of Nature and of art. If produced artificially from other organs, the curative effect will be generally the greatest in proportion to the importance of the organ; and will so far depend upon reflex nervous actions set up by the vital changes which give rise to the increased product; as when cathartics augment the bile, the intestinal mucus, &c., or antimonials the perspirable matter. Hence, it will be seen that the vital changes induced will depend, in any given form of disease, upon the nature of the cathartic by which the bile or intestinal mucus is augmented. Calomel, or jalap, or castor oil, &c., may be speedily curative, when aloes, or elaterium, or croton oil, &c., may be as speedily fatal. So, again, as to "sudorifics," as they are called. Antimonials or ipecacuanha, for example, though they but soften the skin, may overthrow the most profound inflammations, when hot water, or herb teas, would be perfectly inefficient, though they bathe the skin in perspiration. "Sialogogues" fall under the same philosophy. Horseradish is one of them; but though its mastication may keep up a flow of saliva, it will only aggravate an inflammation which mercury, without salivation, may soon subdue. We come thus to understand how all remedial and morbific agents affect the vital states in conformity with the exact virtues of each agent and the existing condition of parts upon which their effects may be exerted (§ 150). We are thus enabled to understand why the vomiting which is produced by an offensive odor, or by tickling the fauces, or by disgusting objects, or any other mental emotion, or by warm water, is less effective in breaking up disease than when produced by an infusion of mustard seed; and less from the last than from the sulphate of zinc, and less from this than from ipecacuanha, and often, perhaps, still less from ipecacuanha than from tartarized antimony, and perhaps often still less from either than from ipecacuanha and tartarized antimony combined. One agent impresses the organic properties of the stomach more profoundly and in a different way from another, and therefore excites and modifies the nervous power in a way peculiar to itself, which, when reflected upon the diseased parts, will affect their condition in modes corresponding with the peculiar impression that had been made by the nauseating influence exerted on the mucous tissue of the stomach (§ 226, &c.). And so of every other remedial agent which produces its effects upon remote parts by primary impressions upon the gastro-intestinal mucous membrane, or the skin, or any other organ. The same is also equally true of mor-

bific agents (§ 650, 653). And here, through the foregoing philosophy, we may understand the reason for the differences in results between the action of cathartics and the analogous effects of emetics upon the intestine. We may regard it, for example, as manifested by tartarized antimony in the double aspect of a curative and morbific agent as it may happen to prove emetic or cathartic. If it fail of the former effect, it will, nevertheless, have produced more or less of that profound impression upon the stomach which is peculiar to its own virtues in their relation to the gastric mucous tissue, and when it passes on to the intestine it exerts not only a more depressing effect upon the whole organism, but may act upon the intestine as a profoundly morbific cause, and develop reflex nervous influences that light up inflammation in the lungs, or extinguish life, as is often the case, ere its purgative effect has ceased (§ 150, 226, 228). The fundamental principles are the same throughout, and rest mainly on reflex action of the nervous system. No chemical, physical, or humoral hypothesis can withstand its force, for a single moment, with the enlightened practitioner. In a practical sense, it should be the perpetual study of physicians; the touch-stone, as it were, by which all remedies are selected (§ 149–154, 222–233⅘, 475½, 500 *k–nn*, 514 *f*, 647½, 891½ *k*, 893 *a*, *c*).

A great variety of other practical conclusions follow in the train of the foregoing principles. We see, for example, from what is known of the rapidity with which emetics produce vomiting, and the reaction which speedily follows, that they exert their alterative effects upon diseased parts with great suddenness, and that the influence of merely nauseating doses of the same agents may be exerted more gradually, and may therefore, according to the nature of their virtues, be more profoundly alterative. The depressing nausea which precedes the emetic effect of tartarized antimony may be remarkably productive of an alterative influence upon all the organs of the body (§ 514, *h–m*); prostrating the circulation, and, when prolonged, removing croup, or pneumonia, more effectually, perhaps, than by the speedy operation of an emetic. Hence, also, it is obvious that emetics are mostly useful, in their therapeutical aspect, soon after the invasion of disease, when unembarrassed by the force of vital habit (§ 535, &c.), or during the intermissions of fever when nature is inclined to the restorative process, and when, as in either case, she may require only a sudden and temporary shock to place her permanently in the right way.* The philosophy of their success in these cases appears to be perfectly simple. The morbid change, in one case, having but just begun, and Nature, in the other, being inclined to restoration, reflex nervous influences which radiate from the stomach during the action of an emetic easily establish new changes in the diseased conditions, when the properties of life are enabled to obey, at once, their natural tendency to return to a state of health. This simple principle, therefore, leads us to understand that the most auspicious time for administering an emetic in intermittent fever is when the stage of intermission is fully formed. There is now the greatest suspension of morbid action, and the organic states are going the right way. We critically seize this moment to prevent Nature passing again into a state of incubation; or, perhaps, a better time is not long before the expected access of a paroxysm, since the artificial change being made about the time of the access, the predisposition is so crippled at this particula.

* See p. 298, § 476½ *h*.

juncture that the artificial change breaks up, most effectually, the succession. This interruption of the access of a paroxysm destroys the paroxysmal habit, and the disease is at an end.* The same philosophy is here concerned as that which respects the influences of bloodletting just before the access of the cold stage, and goes to illustrate the modus operandi of that remedy (§ 986, &c.). But the most advantageous time for bleeding, if not demanded by some inflammation, or by high arterial action during the rise of the hot stage, is soon after that stage begins to subside; and this, next to the time just antecedently to the expected access of the cold stage, is the best period for administering an emetic; and this, also, is the best period for the exhibition of a cathartic, unless given along with the emetic before the access of the cold stage. The same philosophy applies whether Nature be engaged in a restorative movement or be about to enter upon a state of incubation. The expediency as to time depends upon the kind of remedy. In either case Nature may be readily turned into her favorite course. Conditions are instituted which correspond with those through which the morbid properties take on spontaneously the progressive changes that result in health; as shown by the coincidence in the immediate results of the remedies, and those which ensue at more distant times when no remedies have been applied. In either case, whether the artificial or the natural, sweating breaks forth, the secretions of the liver, of the intestinal mucous tissue, of the kidneys, &c., are poured out. By anticipating nature we aid her in consummating her efforts at relief; while the artificial change so far transcends the spontaneous improvement that Nature is greatly started along in her recuperative process, and often obtains an impulse by which she passes on triumphantly through an uninterrupted series of salutary changes till the properties and actions of life become restored to their natural state (§ 672, 675).* And here we may look at one of the reasons why cathartics are more remedial than emetics after disease becomes established; for, although very profound reflex nervous actions may be determined by emetics through the mucous tissue of the stomach, the impression upon that organ, as exerted by the most curative, is much more transient than that upon the intestine by the best of the cathartics (§ 514 *g*, 516 *d*, no. 6). This, however, is only a principal one among other reasons, of which the difference in *virtue* is the greatest. Hence, an important corollary, that the therapeutical effects of cathartics and emetics, and, indeed, of all other remedies, will depend, other things being equal, upon the particular virtues of the agent, and the time, within certain limits, during which it may act upon the gastro-intestinal mucous tissue (§ 516 *d*, no. 6).

We may remark, also, as intimately related to the principles and practice now under consideration, and as farther illustrative of the importance of adapting our remedies to the precise pathological condition of any given form of disease (§ 675, 870 *aa*), that cathartics, unless united with an emetic, are apt to be detrimental if exhibited just before the access of a paroxysm of intermittent fever, and to bring on the attack. But this is less the case with an appropriate cathartic, such as calomel and jalap, if associated with an emetic; since the operation of the cathartic is then more immediate, less prolonged, and its general irritation more or less counteracted by the prostrating effect of the emetic It is the same principle which is concerned wher

* See NOTES K L pp. 1119, 1120.

antecedent loss of blood lessens the constitutional irritation of cathartics, or when the prostrating effect of an emetic prevents the abstraction of blood, however apparently different in the two cases. The principle reaches very far into the philosophy of medicine, and concerns, especially, the order in which remedies should be applied. As one of its more obscure details, I may say that the union of opium with a cathartic, for the purpose of moderating the irritation of the latter, is exactly equivalent to either of the immediately preceding examples.

From what has been just said, we readily see one of the principal distinctions between cathartics and emetics. The non-stimulant emetics reflect a nervous influence which depresses the circulation throughout their widest range but excites perspiration as a consequence of salutary changes, while, on the contrary, cathartics are more or less apt to stimulate and excite the circulation at first, and do not often affect, in a sensible manner, the functions of the skin. A knowledge of these differences, as well as of the analogies which prevail among the influences and results of different remedies, and also of their modus operandi, is indispensable to a successful application of those suggestions which are afforded by Nature in her unaided efforts at restoration.—Note Ee p. 1133.

863, *e*. In respect to the curative influence of increased effusions, much will depend upon the intrinsic nature of the product which artificial or natural changes may bring about (*b*). By the natural process, in local inflammations, lymph, and serum, and pus are a good deal alike in the amount of effect (§ 732, *d*), and redundancies of bile are next in the relief of hepatic derangements. Least of all, in respect to organic products, is increased mucus. But this will depend much upon the nature of the part. It is most curative in inflammations of the lungs, far less in intestinal inflammation, and still less so in inflammation of the bladder (§ 133, &c.). The inorganic products contribute very little, by their augmentation, to the curative process, whether naturally or artificially induced. Perspiration is more so than urine. When these products, however, flow abundantly, the salutary effects depend mostly upon the vital changes from which the redundancies emanate. Humoralism, on the other hand, imputes all to the augmented product (§ 514, *h*). That is the difference between solidism and philosophical humoralism. The former detects the cause and renders it his polar star in his philosophical and practical movements; the latter mistakes the effect for the cause, analyzes the blood, or the saliva, or the urine, and according to the real, or artificial, or imaginary developments of the test glass and crucible, he neutralizes an acid or an alkali, purges off ozmazome, or picromel, or cholesterine, and taps the abdomen to cure the dropsy; while the charlatan "holds up the mirror," and all the world believes the shadow reflected "Nature" (§ 5½, 349 *d*, 851).

863, *f*. But Nature has one means of depletion which stands for all the rest. And so it does in the hands of art. This, I need not add, is loss of blood. Here Nature and art meet upon common ground. Both interpose the remedy for the direct subversion of disease, and both equally prevent thereby the formation of other products (§ 805, 890 *d–g*, 1019). Indeed, such is the magnitude of this remedy, and such its direct effect in changing pathological conditions, that I shall enter largely upon the philosophy of its operation, and its applicability to disease.—Notes Ff p. 1114, Ff p. 1135, Gg p. 1138, Ii, p. 1139.

863, *g*. What we have now seen of Nature and of art, in respect to inflammatory diseases, is equally true of fever. The effusions, however, which Nature institutes in fever are less various than in inflammation, and proceed from organs connected with the external world. But here they are more universal, and it is here as fever is complicated with venous congestions that Nature makes the same demonstration with the *remedium principale* as she does in obstinate affections of the lungs, or the stomach (§ 805).

863, *h*. It is a common event for disease to persist until great emaciation, and other signs, denote approaching death, but, notwithstanding, for the restorative process to set in, and where no secreted products had apparently contributed to the change. In these cases, however, the emaciation has been more or less an equivalent. And here, again, a lesson may be taken from Nature, on the subject of diet, by those who will not listen to her law as proclaimed by the instinct of animals. But even where disease is maintained by errors in food, there may be yet remaining hope from emaciation (§ 1007 *h*).

864. It appears, therefore, that the salutary changes which occur spontaneously in all inflammatory and febrile affections lead to a variety of evacuations from the secretory and excretory apparatus, and within the organization, of which effusions of blood are the most efficient. Art, in its imitation of Nature, has proved that she is the only guide; and since fever and inflammation comprise all the severe forms of disease, and as there is nothing in the results of spontaneous changes which correspond with those induced by tonics and stimulants, we may safely conclude that those practitioners who often resort to that class of agents have but very imperfect views in physiology and pathology, and are astray from the path of Nature.—Note Ee p. 1133.

865. No remedial agents are truly specifics; though, for conventional purposes, the designation is useful. Mercurials will often fail of curing syphilis, where a non-stimulant diet may succeed alone. Cinchona may exasperate an intermittent, when arsenic or cobweb would readily succeed. There is no remedy, indeed, however adapted to the cure of any given disease, which will not sometimes fail, and admit of a substitute apparently quite different. Bloodletting, cathartics, &c., will generally remove intermittent inflammation; but cases occur in which the special *febrifuge* virtue of cinchona is necessary.

866. All remedies, therefore, are only so in relation to diseases upon which they may exert salutary effects (§ 149, 150). Cinchona, for example, is a remedy for intermittent fever if no local diseases of severity exist; but if so, it will commonly exasperate the fever, and is then a morbific agent (§ 854, 857). Its *tonic* virtues then transcend its *febrifuge*, of the first of which arsenic and cobweb are destitute.

The former of this remarkable combination of virtues may be the best for enfeebled states of the system, or of the stomach, if no inflammation be present; otherwise, it is morbific It should be constantly before us, that a tonic, an antiphlogistic, &c., are only such when appropriate to the case before us. With this understanding, we are led to investigate the exact pathology of the case, and its various attending circumstances (§ 673, 675, 685, 686).

867. The curative effect of remedies is more or less progressive. When the primary state begins to give way, a new pathological condition is introduced, and so on in regular progress where there is an

uninterrupted decline of disease (§ 672). But it rarely happens that diseases are diverted from the essential pathological character with which they begin.

The curative effect commences at the first moment a favorable impression is made upon the seat of disease or upon any part capable of participating sympathetically in the restorative process, and terminates when that exact change is made in the diseased properties and functions which is most conducive to their spontaneous recovery. When remedies are carried beyond that point, they are apt to become morbific. Hence it is one of the most important, but difficult acquisitions, to determine when our remedies should be discontinued, or moderated.

868, *a*. It should be a great object of art to render the associated train of pathological states as short, and make it consist of as few changes, as possible. In a general sense, therefore, where disease is intense, the first remedial impressions should be strongly made ; but, in doing this, the right agents should be selected. It would answer, for instance, to exhibit a decisive dose of calomel and jalap, at the onset of pneumonia ; but it would be sad practice in inflammation of the intestine. Bloodletting, however, is adapted to either case, and is the right initiatory remedy for both.

As the favorable changes advance, our remedies should become milder and milder, till that critical point is attained where Nature requires only the occasional interposition of art to accomplish the removal of some slight obstacles that are more or less liable to spring up during convalescence; such as constipation, deficient secretion of bile, &c.

868, *b*. Our remedies may be perfectly right, and yet disease shall increase by the force of its intensity (§ 685, no. 9). In such a case, however, we may have fallen short of the due amount of the remedial agent; and this we shall see to be often true of bloodletting. But it is rarely so of any internal agent; there being a prevailing disposition to medicate largely. We have thus a positive abuse of drugs and a negative abuse of bloodletting. Being sure of the right, we should steadily pursue it; repeating the remedy, or associating, or substituting, others of analogous virtues in relation to the case before us, till their effects are pronounced by a manifest decline of the symptoms.

869. The rapidity with which the full salutary changes will be effected will depend upon a variety of circumstances; but mainly upon the period of the disease. All diseases being most easily and speedily arrested near the time of their beginning (§ 557, *a*), the difficulties increase in proportion to their unmitigated duration, or any increase they may sustain. They soon begin to acquire the obstinacy of a morbid habit (§ 535, &c.), to involve sympathetically other organs, and to result in disorganization, effusions of serum, &c. (§ 660, 712–718, 732 *d*).

870, *a*. Some remedies, in their greatest proper latitude, make a decisive impression much sooner and more effectually than others, under the same circumstances of disease, and where either may be appropriate. Bloodletting, in inflammations and fevers, operates far more immediately and decisively than any other remedy, and cathartics are generally next. And so of many individual cathartics which may be appropriate to a given condition of disease. The saline may be slowly and moderately useful, and some of them better than oth-

ers; castor oil more speedy and effectual; jalap more so; calomel far more so; and the united force of calomel and jalap may greatly transcend either. Sometimes, however, as we have seen, a fever at its onset may be completely subdued by the alterative action of an appropriate emetic. Tartarized antimony will do it with the greatest certainty; ipecacuanha comes next; but most of the other emetics would be perfectly useless or detrimental. The union, however, of antimony and ipecacuanha improves the useful *alterative* virtue of each, and lessens the chance of morbific action from the antimonial (§ 150).

870, *aa*. Remedies sometimes operate with great and rapid effect upon one part of a compound disease, but may fail in respect to other parts; or, if not justly applied, they may assuage a part of the disease, but, from their want of proper relation to other parts, they may prove morbific to these conditions, and thus indirectly reproduce that part of the malady which they had been instrumental in subduing. But this will not happen with the right remedy (§ 150, 552 *b*, 665, 848). Bloodletting, for example, may quickly subvert pneumonia when complicated with small-pox, but will not shorten the natural progress of the more general malady (§ 858). But the remedy will now be perfectly compatible with the whole condition of disease; since the local inflammation has brought the specific form under its influence, and bloodletting now operates in conformity with the law of adaptation (§ 137 *c*, 143 *c*, 847, &c.). Through the same law quinine may be peculiarly salutary in some cases where pleurisy is complicated with small-pox, if the former affection be owing to the remote causes which generate intermittent fever; but will exasperate the whole condition of disease if the pleuritic affection be owing to any other cause. Much, also, may depend upon a coexistence of different virtues in a remedial agent, especially in connection with the amount of its doses. Thus, quinia, in the dose of five or ten grains, may speedily arrest an intermittent fever by its *febrifuge* virtue. But that is bad practice; since, by its associate *tonic* virtue, it is likely to increase or to induce local congestions; thus leaving the patient imperfectly cured and subject to relapses (§ 769). But, in these cases, the local inflammation and venous congestion are so apt to be modified by the predisposing cause of the febrile affection, that repetitions of a small dose of quinine may be curative as to the whole condition of disease. I have twice seen, in my own family, the most formidable grade of remittent fever, of long duration and attended by the foregoing complications, ardent heat, thread-like pulse, loss of mind, &c., and where hope of recovery had been abandoned, yield to less than a grain of quinine, divided into sixteen doses (§ 137 *d*, 662 *b*, 756, 811, 813 *b*, 857). There had been repeated bloodlettings &c.*

870, *b*. This leads me to say, that the best experience sustains what is enforced by my interpretation of the modus operandi of remedial agents, that simplicity of treatment should distinguish the course of the practitioner. Where diseases are circumscribed, he will have little need of variety; while, on the other hand, the more compounded the affection the more likely will it be necessary to bring several agents into operation. In simple pleurisy an appropriate loss of blood may be the only requisite means, and an emetic at the invasion of croup. But if pleurisy be complicated with congestion of the liver, or with idiopathic fever, &c., several other agents may be necessary to meet these complications. Much, however, will depend upon

* See NOTES K L pp. 1119, 1120.

the stage of the disease when the treatment is begun. There must be harmony, however, among the virtues of the several agents, conforming to the general modifications of disease, and the existing susceptibilities to their influence (§ 150, 870 *aa*, 871, 888 *b*).

871. We have variously seen how the susceptibility of organs to the influence of remedial, as well as morbific, agents may be increased by antecedent impressions from other causes (143, 145, 149, 150, 556, &c.). This is fundamental in therapeutics, and carries us back to preceding statements (§ 672, 867, 868). The administration of remedies proceeds greatly upon this principle. One prepares the way for the favorable operation of another, or which last might be otherwise injurious. A remedy which is curative under one combination of circumstances may aggravate disease when that combination is a little varied. The cathartic which would not irritate intestinal inflammation immediately after bloodletting might greatly exasperate the disease if exhibited without the antecedent loss of blood. And so of vesicants, &c. Indeed, so profoundly and rapidly curative is bloodletting of inflammatory affections, and so greatly does it promote the useful effects of other remedies, or prevent their morbific action, that, whenever it is indicated, it should precede all others; and then it will be often found that it has taken the place of all others.

Hence a great doctrine in therapeutics, that the order in which remedial agents are applied should be in their best individual relations to the existing pathological state, whether that state may depend exclusively upon the primary causes, or as modified by the subsequent treatment (§ 137, *d*, &c.).

This principle, however manifest, enforces a thorough knowledge, not only of physiology and pathology, but of the exact capabilities of remedial agents, of their various doses, and of their modus operandi, in any given pathological state. Its highest practical attainment is the highest consummation of medical skill and science. It is the *ne plus ultra* of medicine (§ 857).

872, *a*. The last section involves the principle which is concerned in the combination of medicines. By the union of two or more, and according to the exact virtues of each substance, and according, also, to the proportion of each, we create, as it were, a new remedy,—add a new one to the Materia Medica. It is thus seen that art may multiply remedial agents to an almost endless extent; and this explains the reason, in part, why the most enlightened practitioners do not often seek for desirable virtues in the inferior medicines. By variously combining two or more of a limited number new virtues are evolved, however analogous, in almost every prescription for disease.

By this process, what might be otherwise highly morbific may be rendered curative. The cathartic, which given alone might aggravate intestinal inflammation, may be often rendered safe and useful by the addition of a little opium or hyoscyamus; and thus, too, the necessity of antecedent bloodletting may be sometimes avoided. The narcotic so lessens irritability that the cathartic is innoxious, and is thus enabled to establish a favorable pathological change. How adverse to humoralism this single example, how confirmatory of the doctrine which I have taught of the action of remedies upon the properties of life (§ 188 *a*, 189, &c.)! Add to the cathartic, guarded by the narcotic, a grain, or more or less, of ipecacuanha, and new alterative

influences may spring up, of great power and extent; each ingredient, and according to the proportion of each, modifying, increasing, and extending the reflex nervous actions, but in such a combined manner that the compound acts as a whole, and not by its individual parts (§ 188½ *d*, 224, 500 *k–nn*, 514 *h*, 889 *k*, 891½ *k*, 896, 902).

Take another example; for these examples not only illustrate important principles, but are, in themselves, practically important. In a case of common remittent fever, near its invasion, we may proceed with decision, employ bloodletting, calomel and jalap, and speedily pretty well overcome the disease. The most that the patient will immediately afterward require will be rest, low diet, and mild influences by certain cathartics. The best of these, till the bile begins to assume a good yellow color, will be small doses of castor oil; for this cathartic exerts a peculiarly alterative influence upon the liver. When the dejections shall have put on a natural aspect, castor oil begins to irritate the intestine rather injuriously, and this effect increases as its repetition goes on; although given, perhaps, in the dose of a tea-spoonful, or a half tea-spoonful only, to an adult. It is also then apt to nauseate the stomach and prostrate the strength. Convalescence has now advanced too far for this active agent, and some other should be substituted to maintain a free secretion of bile, and to procure one evacuation, at least, daily. But I know of no mild cathartic which is exactly suited to this state of things. If we employ moderate doses of Rochelle salts, they operate too superficially; mainly upon the mucous tract of the intestine, and are also apt, in this condition, to irritate that membrane injuriously. Magnesia is liable to the same objection as it respects the superficial effect; and rhubarb alone is too stimulating to the whole system, and to the mucous tract. But it has the advantage of extending its influences to the liver, and of promoting the tone of the stomach and of the whole system, when this part of its tonic and stimulating effect can be properly restrained.

Now, the foregoing three agents in combination, and in proportions adapted to the state of the case, are exactly suited to the convalescent from fever who has passed the stage when castor oil ceases to be useful. The magnesia corrects the irritating effects of the Rochelle salts, and neutralizes any acid that may exist in the primæ viæ, while each counteracts any injurious stimulant action of the rhubarb, so only the proportion of rhubarb be not too large. The rhubarb, also, in its turn, gives tone to the digestive organs, counteracts the prostrating effect of the saline substance, and imparts to the whole compound a reflex nervous action over the liver, by which a free secretion of bile is maintained till health is established.—See Note Ee p. 1133.

Nature has carried out this principle of combination very extensively, and has thus supplied, in numerous substances, a variety of virtues in each one, which are exactly adapted to the varying exigencies of disease. We see it strongly pronounced in the cathartic, tonic, and astringent properties of rhubarb; in the febrifuge and tonic virtues of cinchona; in the soporific, anodyne, and relatively astringent properties of opium; in the narcotic and laxative virtues of hyoscyamus, &c. Indeed, so manifold is this union of virtues, that art has availed itself of the opportunity, and elaborated many in the form of the alkaloids, &c., by which greater simplicity is obtained.

It is not unusual to meet with prescriptions in systematic, labor-

saving works, embracing several articles, with definite proportions of each, which are said to be adapted to certain forms of disease. This practice is not only wanting in philosophy, but is clearly empyrical; since the adaptation of remedies, both as to the ingredients of the compound, and their relative proportions, should be adjusted by the united circumstances of every case, as they may exist at the moment; especially in all the forms of acute disease. It is manifest, therefore, that this great object of medical science can be fulfilled only by a careful investigation of every case whenever a prescription is made. It implies a great range of inquiry, an accurate discrimination of the pathological conditions, and an intimate knowledge of the virtues of each remedial agent (§ 686, *d*). Hence, also, the voluminous reports of cases, with or without the "numerical method," are only useful for the institution of principles in medicine (§ 672, 867). It is so with every thing, with food itself in every case of disease. The principle extends even to light in the treatment of ophthalmia; which also supplies another proof of the coincidence in the philosophy that relates to the operation of light and other vital agents (§ 74, 188½. *d*). And so with the agreeable emotions of the mind (§ 500, 539 *c*, 855, 1067).

If the reader will now attend, in connection with the foregoing principle, to what has been said of the nervous power (§ 222, &c.), of its laws of reflex action (§ 500, 512, &c.), and to other special circumstances which favor the operation of remedies (§ 143 *c*, &c., &c.), he will readily perceive the extent of his power in the judicious combination of a few only of the best remedies. But, to accomplish this art of combining remedies, in connection with the requirements in the preceding section (§ 871), demands an acquaintance with the whole ground which forms the basis of therapeutics.—Note Ee p. 1133.

872, *b*. And yet I would not abandon any part of the materia medica. I would hold it all, and all in connection; that what is good may be compared with what is indifferent or bad, and our knowledge of remedial virtues and remedial action be thus extended. There is also scarcely a recognized means of cure but is hallowed by the service it has done, and which it may do again, in enlightened hands, where the better means are wanting. It was with such intentions, and to promote the habit of a critical investigation of each member of the materia medica, that I was prompted to an attempt of arranging the whole according to their physiological aspects and therapeutical capabilities.

873, *a*. It is an important circumstance to be recollected, that many remedies are cumulative in their effects when employed in small doses; while the effects of others, on the contrary, lessen by use (§ 549–559). The action of the former, therefore, should be carefully observed during their progressive administration, that they may be promptly diminished or discontinued. The latter are not obnoxious to the equal objection of becoming morbific, as they must be often increased to obtain progressively their original effects; but much may be lost by neglecting the ascendency of habit in its aspect of diminished susceptibility (§ 535, &c., 841, 889 *b*).

These two important groups, however, are liable to some essential modifications. Mercurials, for example, in their constitutional alterative sense, are cumulative in respect to most adults, but very little so in regard to children, who are generally insusceptible of salivation

Again, in respect to agents which become inoperative from habit, this is often true of them only in certain small doses, and when frequently repeated. Tartarized antimony, in its minimum doses, generally diminishes the irritability of the stomach. But, if carried to the point of nausea, its effects will then be often cumulative, and the dose must be diminished, or incessant and aggravated vomiting may follow (§ 556, 841). Opium, hyoscyamus, &c., lose their effects, more or less, from habit, when continued at certain intervals, as twelve hours, and the dose, if expedient, may be increased; but if repeated as frequently, perhaps, as once in six hours, or less, they are cumulative, and the dose must often be diminished. By-and-by, however, under this frequency of exhibition, irritability becomes obtuse in relation to the agent employed, the opposite influence of habit obtains, and the dose must be increased to procure the original effect.

Many agents continue to produce about the same effects in the same doses, administered at certain intervals, however long continued. Such is true of ipecacuanha, and those vegetable substances which are allied to it. So, generally, of iodine, and many of its combinations. Much, however, depends upon the intervals between the doses. Unlike tartarized antimony, which it resembles in so many respects, ipecacuanha is cumulative as the intervals shorten below four hours, when the dose is a grain. The ipecacuanha will then often produce nausea and vomiting, while the antimonial, though repeated at far shorter intervals, is apt to lose its effect unless progressively increased to an extent which would prove emetic at the first dose.

873, *b*. In larger doses, or in their greatest admissible extent, all the foregoing agents are apt to be cumulative. This is true of the frequent exhibition of cathartics and emetics, though more so of some than of others. The dose of aloes which purges from the beginning must be often greatly lessened at the subsequent doses; or what was originally only a mild effect may soon become a violent one. This is also remarkably true of castor oil. All the cathartics, also, when administered daily in small doses, commonly raise the irritability of the intestine, and operate with increasing energy, though in some of the cases a part of the result may be due to an increased production of bile (§ 516 *d*, no. 6, 556 *b*, 841, 889 *m*, *mm*, 902–904, 1057 *l*).

874. It is an important circumstance, philosophical and practical, that the operation of narcotics is remarkably influenced by pain, and by certain states of the great centre of sympathies, as in *delirium a potu*. It is fatally opposed to the physical hypotheses, and to therapeutical conclusions from experiments on animals or on man in a state of health.

It is also interesting to the medical philosopher that pain has no remarkable modifying influence upon any remedial agents excepting the narcotics; and of those, such only as have a special relation to sensibility (§ 194, &c., 891).

875. We have now seen, in a general manner, that the susceptibility of the vital properties to salutary impressions, and their inherent tendency to a state of restoration when driven by disease from their natural standard, has given rise to two general modes of treatment, which are familiarly known as the *active* and the *watching* or *expectant* (§ 853).

876. The *active* method consists in the application of such remedies

as produce artificial impressions. It comprises all that is attempted by art, in a direct manner, to promote the natural curative process. By this method, therefore, we forcibly institute those new pathological conditions which are most conducive to a return of the natural physiological states (§ 150, 854 *b*, 855, 856, 901, &c.).

877. The system of *watching*, or the *expectant* plan, leaves Nature mostly to herself; only keeping obstacles out of her way. In its greatest latitude its advantages are exemplified in the self-limited diseases; but there is a period in all dieases, terminating favorably, when art should surrender the case to Nature (§ 858, 861, 867, 868 *a*).

878. So many evils have resulted from abuses of the *active* method, that great numbers, not considering that Nature is embarrassed in these cases by ignorance or carelessness, and, withal, having erroneous views in physiology themselves, do little else than *watch*. This is remarkably true of the homœopath, whose lessons from Nature have taught physicians that all the virtue does not lie in the amount of doses, and that a foe has arisen who can be exterminated only by consulting the philosophy of disease, and the *modus operandi* of remedies.

Nevertheless, although medical philosophy and a knowledge of the mode in which remedies operate be indispensable to the right treatment of disease, the community look only at the results; and while the homœopath cultivates his mind, there will be no inquiries, no interest, as to his theories. In America these innovations cannot prevail extensively, since the contrast will be vastly on the side of our Hippocratic practice (§ 709). But, in every section of the country there are some who are prone to a large and indiscriminate medication; and while this evil exists, homœopathy, in its original *practical* sense, will make its more successful demonstrations. Nor can it be doubtful that the tonic and stimulant practice which has risen in our cities, and which still sways the British profession (§ 621, *a*), would yield a harvest to those who suffer Nature to take an unmolested, however unaided way.*

It is due, however, to truth (*fiat justitia ruat cælum*), that the physiologist concede to the homœopath that his hypothetical views may be directed by an enlightened understanding of the properties and laws of healthy beings. Upon that ground, indeed, his hopes can alone repose; and even his doctrines in pathology and therapeutics are a thousand-fold better, more rational, more consistent, more conducive to health and to life, than any or all the tenets of the chemical and physical schools. With the one there may be a great deal of misapplied philosophy; with the other there is certainly none at all (§ 892, *i*).

879. It appears, therefore, that the active and expectant modes of treatment should be more or less associated; either taking the lead according to the general character of the disease, and the particular circumstances of individual cases. Having made the requisite impression by the *active* method, we should *watch* till another remedial change may be advantageously produced. When all is steadily in the right way, we should do nothing but watch. Another impression by an active agent would disturb the restorative process, and might so derange the vital states as to establish a condition of disease which art and nature together might not be able to surmount (§ 137 *d*, 150, 151, 854).

* See Dr. FORBES's "Young Physic.;" also, Prof. LAWSON's, and MEDICO-CHIRURGICAL's *Reviews* of the same, 1846.

880. Having, I say, placed the morbid conditions in the right way for their subsidence into health, but little else remains than to withdraw, in good time, the active interference of art. Much, however, as I have said, may remain to be accomplished by what may be called restorative means; such as a well-regulated diet, exercise, exposure to the air, &c. (§ 855). In protracted diseases Nature may also require the aid of tonics and stimulants; and this is mainly the advantage which they bestow. They are rather, therefore, adjuncts to medicines that are curative, than positively curative themselves. The same is also true of those narcotics which address themselves to exalted sensibility or irritability.—See Note Ee p. 1133. Also Note F.

881. Though by the system of watching we intrust Nature with the cure, the active interference of art may be demanded by supervening obstacles. Such is the case, as we have seen, when visceral inflammations spring up in the self-limited diseases (§ 858). In these affections, also, in their simple states, general arterial excitement may become so excessive as to require the loss of blood, or alterative doses of tartarized antimony, &c. The remedies are designed for these specific objects, and not with any expectation of arresting diseases which have a strictly natural course and termination. The same principle is applicable to all other forms of disease; according to the nature of the contingencies that may arise after the restorative process shall have been introduced. It is alike employing constitutional laws

882. It is no uncommon prejudice that certain local, and even constitutional forms of disease should be allowed to continue for the prevention of some apprehended greater evil. This practice is founded upon the humoral hypothesis, and is one of the strong exemplifications of the fallacy of that doctrine. The intermittent fever is thus allowed to persist, that some peccant matter may be concocted and expelled; ulcers are cherished as outlets to vicious humors, &c. But, we are never benefited by the continuance of natural diseases. The sooner we get rid of them, the more shall we insure the chances of prolonged life, enjoy an exemption from corporeal and mental suffering, and manifest our common sense.

883, *a*. In considering what is to be done in the treatment of disease, we speak of the *Indications*. These consist of the suggestions that may be afforded by all that relates to the state of the patient. They refer to the symptoms, the seat of the disease, its remote and pathological causes, its duration, the habits, occupation, temperament, constitution, age, and sex (§ 686, *b*).

883, *b*. And here we may go back to the origin of our Science for one of those summary statements which can flow only from an enlightened and comprehensive view of organic philosophy, and which no subsequent observation has improved.

"Consider well," says Hippocrates, "the nature of causes, the nature and seat of the disease, what is most suitable to-day, and what to-morrow, what the vigor and what the mildness of treatment. A neglect of either may be fatal to the sick. Reason as a practitioner, and practice with reason." "Again, an important thing to be done is to consider the seasons of the year, the various changes, and the differences of their effects. Next, the winds, particularly such as are common to all nations, and such as are peculiar to certain countries." "The knowledge of disease is to be obtained from the common na-

ture of all things, and from the nature of every individual; from the disease, the patient, the things that are administered, and the person that administers them, for the case becomes easier or more difficult accordingly. We are, also, to consider the whole season in general, and the particular state of the weather, and of every country; the customs, the diet, the employment, the age, of every one, the conversations, the manners, the taciturnity, the imaginings, the sleep, the watchings, and the dreams; and how far vellications, itchings, and tears, are concerned; and what the paroxysms are; what the evacuations by stool, or spitting, or vomiting may be; and what changes may happen from one disease to another, and their various consequences. Sweat, cold, shivering, cough, sneezings, sighing, breathing, belchings, flatus (secret and audible), hemorrhages, and hemorrhoids, are also to be considered, together with the consequences of each" (§ 5½ *a*, 350⅔, 821 *c*–823).—NOTE Oo p. 1141.

884. When the foregoing indications are subjects of attention we pursue the *rational* system, which is so called in contradistinction to the *empirical*.

The *rational* treatment looks, also, at the physiological states of the body, and considers disease in its relations to those states. It is constantly concerned about the laws of vital actions, and regards disease as consisting in their modifications. In short, it proceeds upon the broad ground of inductive philosophy, and, therefore, takes in its scope all the principles of medicine (§ 639, *a*).

The *empirical* practice, on the contrary, discards every thing but a few prominent symptoms, and would as soon relieve the pain of pleurisy by opium as that which attends a spasm of the stomach. Such, rather, is the common acceptation of *empiricism*. But, it is more a prevailing usage with the ignorant, and with those who discard the rational treatment, to be regardless even of abstract symptoms, and to be mostly swayed by the humoral hypotheses (§ 4 *b*, 744, 821, 824, 830, 835).

885. Symptoms, however, are the most essential, in their relative bearing, in the series of indications. They inform us of the organs affected, conduct us to a knowledge of the pathological cause, and frequently contribute their aid in detecting the nature of the remote causes, by which the pathological is determined (§ 644, 667, 678).

A few diseases have a particular symptom which is pathognomonic; as the eruption in small-pox, measles, &c. But signs of this nature are very rare, and still rarer the strictly vital phenomena (§ 682, *b*).

In the great class of inflammations there are certain symptoms common to the whole, which, being more or less present, denote the presence of this disease, and thus become a general guide to the treatment through the light which they shed upon the general pathology. That treatment is the antiphlogistic; but whether it shall consist of bloodletting, cathartics, alteratives, blisters, &c., individually or collectively, and to what extent, will depend not only upon the amount and severity of the general symptoms, but often, also, upon many others less uniform that may relate to each individual case, and which frequently mark some special modification of the common form of inflammation (§ 721, 722).

886. Next in importance to the immediate symptoms, and as often indispensable to a correct apprehension of the pathological cause, is

a knowledge of the *predisposing causes.* This, also, has been amply shown in its appropriate places (§ 644, 742, 776, 813, &c.). To these causes, besides the more immediate, belong the innate tendencies to particular forms of disease, and, more or less, all the natural and acquired temperaments, and all the habitual deviations from the natural standard of a sound constitution (§ 143–147, 561, 661, &c.). It is evident, therefore, where there are many remote causes concerned in the production of any given case of disease, that a few only, perhaps but one, have an important agency. Those few, or this one, are most important to be known; and so of the others in proportion to their modifying influence. In the great families of fever and inflammation there is generally but one principal cause for each modification, which is generally transient, or may appertain to the constitution. In the latter case, as where phthisis pulmonalis arises from the combined influences of cold, moisture, errors in food, &c., I regard these apparently predisposing causes as simply exciting, and assume the natural predisposition as the predisposing cause (§ 661).

887. The great value, then, of a knowledge of symptoms and of the remote causes of disease is that of conducting us to a right understanding of the pathological cause. In forming our indications of treatment from the symptoms alone we may effect the removal of many, but in so doing we may aggravate the disease, and perhaps destroy the patient. This is conspicuously seen in the bark and wine treatment of those congestive fevers which destroy so many of the human family; one symptom only being the guide of practice in such cases. "Debility," indeed, is practically rendered the disease itself by philosophers of the tonic and stimulant school (§ 476 *c*, 487 *h*, 488½, 569, 621 *a*), though it be a mere failure of voluntary power.

888, *a*. It is commonly a simple problem for the enlightened and observing practitioner to resolve the *general* character of any pathological condition. With this knowledge we are ready to act in a certain general manner, or, as it is called, upon general principles. But, there is something far more difficult, though often scarcely less important to be known, in many cases of disease; namely, the particular species, or rather variety, of inflammation, of fever, &c., which any given case may present. Having found this last important point in the cases supposed, and settled the modifying influences of contingent causes, we are fully prepared for all the details of treatment.

888, *b*. Owing to variations in the pathological state of many cases of a common form of disease, but where no fundamental change in the general character of the affection has happened, it may be necessary to employ remedies in apparent opposition to each other. But, in these cases, there is no violation of principle, no inconsistency of Nature. A different conclusion only proves that we do not interpret Nature correctly. To reconcile the seeming inconsistency it is only necessary to recollect the explanation which I have given, that our remedies cure by instituting new pathological states, and that a certain variation of disease from that condition to which loss of blood is generally most appropriate may render stimulants, along with antiphlogistics, the best means for instituting the pathological change that shall be most conducive to the restorative process (§ 752–756, 870–872).

888, *c*. There are a few fundamental points to be carefully consid-

ered in all cases in relation to the effects of remedies. They refer to the principles and details already propounded.

1. The direct local effect of remedies upon the part to which they may be applied.

2. Their effects upon remote parts through reflex nervous action.

3. Their ultimate effects after their direct action is over.

4. The general influence each remedy may exert upon the course and termination of disease.

888, *d.* It is one of the most remarkable facts connected with constitutional principles, that those organs which are most important to life are either within the direct reach of medicine, or they sympathize with such more powerfully and more readily than do the less important (§ 129, &c.)

It is also to be observed that the parts through which we operate artificially, and with which those vast and important sympathetic relations subsist, are of an external nature, and admit the application of powerful remedies to their surfaces.

And yet, again, observe that whenever no useful results would follow the direct application of remedies to other organs, such organs will not admit their application without injury to themselves and to others remotely situated. Nature has therefore kindly given to us two surfaces through which we may act upon all diseases; while she has placed a barrier against the entrance of all morbific agents into those parts where the direct action of remedies would be useless or detrimental (§ 278 and *references* there).

888, *e.* I now leave the subject of therapeutics in its general aspects, to illustrate the doctrines which I have propounded, and to advance the rational treatment of disease, by investigating still farther the modus operandi of remedial agents, and as that philosophy is modified in its connection with the operation of loss of blood. At a future time it will be my purpose to carry the same philosophy through all the details of the Materia Medica.

Before proceeding, however, to the summary consideration of the modus operandi of remedies, I shall make a more practical analysis of the therapeutical effects of certain agents which are capable of a wide range of influences, but between which the resemblances are so obscure as to have contributed not a little to the errors which prevail in respect to the impressions they produce, or discourage others from all expectation of ever attaining any knowledge of their operation beyond their direct manifestations. I shall select such agents for this purpose as will be most conducive to a ready apprehension of the modus operandi of all others, especially the most important and most neglected of all—neglected practically as well as philosophically—loss of blood. Those agents may consist of *cathartics*, *astringents*, *tonics*, *narcotics*, *antispasmodics*, *arsenic*, *Peruvian bark*, or, rather, the alkaloid *quinia*, *iodine*, and *ergot*. The last four will illustrate what is known as *specific* action. In the Peruvian bark I shall also bring into view an agent possessing two prominent and rather opposite virtues, and thus attempt the just application of a compound agent to important problems in disease. So, also, with rhubarb, &c., when speaking of astringents.

While considering the therapeutical uses of the foregoing agents, I shall also indicate their morbific capabilities; and, as an important means of engaging attention, I shall dwell upon their abuses.

The advantages of irritants, applied externally, especially vesicants, will follow in the train; and bloodletting, the first in importance, will be reserved for the last, that it may have the united testimony in its behalf of all that precedes.

I am also prompted to these inquiries by a desire to introduce the treatment of inflammation, fever, and venous congestion, along with my investigation of their pathology, &c.

CATHARTICS.

889, *a*. What I may now say of cathartics is a continuation of what has been set forth in section 863, *d*. Their definition as founded upon their most sensible and uniform effect is—agents which increase intestinal evacuations. But this acceptation scarcely refers to any of their important physiological and therapeutical influences; which are just as intelligible, through the various resulting phenomena, and the laws of reflected nervous actions, as the evacuations they produce.

The increase of peristaltic motion, and the augmented product of the intestinal mucous tissue, spring from the irritation which is exerted upon that tissue by the action of cathartics; and the whole group of these agents are more or less capable of producing those results. It is through this irritation, which is variable in its *kind* according to the nature of the cathartic, that all the remote influences which they exert arise; and as these remote effects depend upon modifications of the nervous power corresponding with the nature of the primary impression, it is obvious that one cathartic may be speedily curative, while others may be profoundly morbific, in certain given conditions of disease (§ 52, 150, 227, 228, 500, 638½, 1088 *d*).

But cathartics exert, also, important effects upon remote organs by continuous sympathy;* as upon the stomach, and especially upon the liver (§ 498). It is extremely common, for instance, when a cathartic is about operating, for nausea or vomiting to take place; which, however, may result from remote as well as from continuous sympathy. And here I bring the analogous influences of leeching into connection with the illustration to which I formerly adverted (§ 498, *f*, *g*). By the foregoing manifest irritation of the stomach we see, also, how the vital condition of that organ may be at the same time profoundly affected, either for better or for worse, by the mere action of cathartics upon the intestine. And that this is truly so is evident from the manner in which we often see gastric disease subside, or produced, or increased, immediately after the nauseating effect of a cathartic. But, should the same results happen without nausea, we know from the connection of phenomena now stated, that they have proceeded in the more obscure instance from exactly the same influence, though the prominent symptom of nausea happen to be absent. We thus arrive at the farther knowledge not only that cathartics throw their powerful influence, by reflex nervous action, upon distant organs, in virtue of their intestinal action, and in the same manner as the stomach is affected by the remote process, but how, also, this organ is simultaneously rendered the point of departure of other profound influences upon distant organs;—their main effects depending on reflex nervous actions.

If we now look at what is going forward in the liver, at the same time, we shall see that here, also, are phenomena which denote the same principles, and the same chain of causation. Take, in the first

* *Continuous influence* of these Institutes (§ 129 *c*, *f*, 498 *a*).

place, what is most obvious to the senses, the bile; and we find it often greatly increased during the operation of cathartics. Now it would be clearly wrong to explain this phenomenon upon any other principle than that which I have assigned for the nausea and vomiting; that is to say, by remote and continuous sympathy,* just as muco-intestinal inflammation is extended by reflex and continuous sympathy into the ducts of the liver (*see* § 829). Here, also, as in the case of the stomach, we find that disease simultaneously subsides, or is produced, in the liver, and we know that it depends upon the same causes that had given rise to the production of bile. But this is not all. The liver, from its important connections with other parts, now occasions, as in the case of the stomach, reflex nervous influences upon distant parts, while, moreover, it may yield important relief to the brain, or the stomach, or intestine, &c., through an increased secretion of bile (§ 863). The irritation of the intestinal mucous tissue which determines the nervous action upon the muscular coat (§ 514 *f*) is the occasion of extensive alterative reflex actions upon other structures, and the former phenomenon is a key to the latter, and of the modifications which result in increased secretions, the abatement or increase of disease, etc. Organic actions alone manifest change under such influences, never the muscular, and hence the difficulty of reasoning from the latter to the former (§ 893½).

889, *b*. But, cathartics often produce their full curative effects upon remote organs without determining any alvine evacuation; and this proves to us that the great curative operation of cathartics is of a physiological nature. Nothing, indeed, is more common than to exhibit cathartics when the intestine is empty; and all the good we then obtain from them (and it is often great) arises from those vital influences of which I have been speaking. If much bile, mucus, &c., happen to be discharged in these cases, they are mainly generated during the action of the cathartic (§ 694½). In almost every acute disease of much importance cathartics are administered, and if not with the intention of which I am speaking, they are employed empyrically. When no such specific object is contemplated, they are given merely because it is customary to do so; always excepting the humoral interpretation (§ 456 *a*, 461½, 473 *c*, 478 *b*, 483 *c*, 1058 *d*).

889, *c*. In my *Arrangement of the Materia Medica*, I have placed the chloride of mercury and blue pill as the first in importance among cathartics; and yet their purgative effect is comparatively very little with many of those which I have arranged as the most inferior. This was plainly done for the reason that the curative influences of these mercurial preparations are far greater, in a general sense, than those of any other cathartic. Experience assures us that the arrangement is right; while philosophy, as also founded on observation, enforces the truth that the most drastic cathartics inflict their injuries through exactly the same principles that the less purgative exert their good effects, differing only in the irritations and reflex nervous actions.

We thus see how liable definitions are to lead us astray; and this is true of most of the designations which I have retained in my Physiological Arrangement, and more particularly so of those general denominations, such as demulcents, revulsives, deobstruents, &c., which I have excluded (§ 729 *b*, 819 *a*).

889, *d*. We may make up our minds, therefore, that the mere purgative effect, or the evacuation of the fecal matter, abstractedly con-

* The case is the same here as when stimulants or mechanical irritants applied to the *conjunctiva* instantly excite the *lachrymal gland* to the production of tears.

sidered, is one of the least that is exerted by cathartics; and nothing can be said in behalf of their supposed action upon the blood.

889, *e.* Nevertheless, it should be steadily considered that fecal accumulations are a source of mechanical irritation, at least; or, if they consist more or less of fermented food they also irritate in virtue of their specific properties, and, in both the cases, exasperate remote diseases through the same physiological laws that are relative to the good or bad effects of cathartics. It is then an object to remove these exciting causes. But, if none of the important vital influences of cathartics be then contemplated, we should employ such only as are mild, and whose action does not extend much beyond the intestinal canal. Precisely the same rule should also obtain in the administration of emetics. Tartarized antimony and ipecacuanha are all we want for profound curative virtues; and sulphate of zinc for superficial action, or, at most, associated with one of the others where gastric irritability is rendered obtuse by narcotic poisons.

889, *f.* Does the reader now inquire why it so frequently happens that the best effects of cathartics, in diseases remote from the intestines, are obtained only when they operate decisively, and perhaps powerfully? The answer is important; for it goes far to illustrate the modus operandi not only of cathartics, but of all remedial agents. It is, then, because this strong impression upon the vital condition of the intestinal mucous tissue is necessary to establish those reflex nerv ous actions on remote parts that may be the seat of disease which result in such a change as brings about their own natural curative tendency. The repeated evacuations are a necessary consequence of that requisite impression upon the intestinal mucous tissue, and serve as an evidence that such necessary impression has been produced.*

889, *g.* It appears, therefore, that the results which follow the action of cathartics may affect powerfully all organs, however remote they may be from the intestine, without resorting to the common assumption of absorption, or to any doctrine in the humoral pathology. In all this, too, we are aided not only by our knowledge of the physiological relations of the intestinal mucous tissue to all other parts through the sympathetic nerve, but by its anatomical connections with the liver and skin, and by its vast extent. It is also the seat of some of the most important vital functions, and it is here that the whole lacteal system takes its rise, and here is the great concentration of the sympathetic nerve in the semi-lunar ganglion and solar plexus, with the contributions from the pneumogastric nerve and spinal cord.

It is owing to these vast and important anatomical and physiological connections, that, when disease springs up in the intestinal mucous membrane, it sheds its morbific influence abroad over the whole system; now developing, by reflex actions, cerebral inflammation or congestion; now of the liver; again, inflammation of the skin; at another time, of the bladder; in this subject rheumatism; in that, scrofula; in another, croup; in others, inflammation of the fauces; here, of the eyes; there, of the nose; here, an attack of the gout; there, abortion; and so on, through every part of the organization.

Considering, therefore, I say, the foregoing anatomical and physiological characteristics of the mucous tissue of the alimentary canal, and how diseases of this membrane may give rise to disease in every other part, we may readily comprehend how it is that cathartics exert

* See NOTE G p. 1116.

powerful sympathetic effects upon distant organs when rendered unusually susceptible by disease. And so of all other remedial agents, internally applied, according to the nature of their virtues, their doses, &c. The philosophy lies mostly in reflex nervous actions.

889, *h*. From all which it follows, that three principal advantages are contemplated from the operation of cathartics; namely,

1st. Their sympathetic influences, remote and continuous.

2d. The increased secretions to which they give rise; especially from the intestinal mucous tissue, and from the liver.

3d. The evacuation of the fecal matter, which, in a general sense, is the least of all.

889, *i*. Certain cathartics affect certain portions of the intestinal mucous tissue more than other portions; and this is owing to the peculiar modifications of the organic properties in different parts of that tissue, and the peculiar vital relations of particular cathartics to one or another of those different parts (§ 134–137, 150.) These special relationships should become the subjects of critical investigation, since it often happens that cathartics may be advantageously selected with a view to these exact physiological conditions. The fact is more or less understood, but not so the philosophy. There are some great errors, however, as to the facts. Aloes, for example, is supposed, universally, to exert its effect especially upon the large intestine, while, in truth, its influence is vastly more upon the jejunum and ilium, as abundantly manifested in irritable states of the small intestine, and by the manner in which it aggravates the general arterial excitement of fever and inflammation. The irritation of the highly-sensitive anus which has given rise to the prejudice depends mostly upon the sudden production of morbid bile which aloes elicits by its special influence upon the liver; and this, also, is a proof of its direct and main effect upon the superior portion of the alimentary canal (§ 718). But again, we have an opposite demonstration of the same philosophy in the failure of aloes to be attended by this irritation of the anus in the absence of hepatic derangements; and then, also, there is comparatively little bile evacuated (§1063 *b*).

The great governing principle, however, in the selection of cathartics, should be their known effect upon disease, according to its seat and pathology. If applied with a view to their special action upon one part or another of the intestinal canal, they will be often liable to the worst practical consequences unless the philosophy which I have set forth upon this subject be considered accurately along with experimental observation of the relative virtues of the different cathartics; and, I may add, that the more these relations are studied, the more apparent will that philosophy become in its truth and importance (§ 52, 134–137, 150, 1058 *b*, and *references* there, 1063 *b*, 1065 *b*).

889, *k*. From what has been hitherto said of the philosophy of life, and as modified by disease, we readily understand how cathartics may be greatly varied in their action by associating two or more together, or by uniting with them agents from other groups. Each combination is a new remedy, and a new one, too, according to the exact proportions of each ingredient. How important, therefore, a critical regard to all the details involved in these suggestions! But, there is no problem, I say again, more difficult in practical medicine; and next to that is the right dose of the whole, or of any single agent, and

next in order the time for its repetition, or for the substitution of some other remedy. Such combinations act as a *whole*, and not only upon the intestinal mucous tissue according to their collective virtues, but develop and reflect upon other parts an alterative nervous influence in a corresponding manner. Thus the nervous influence is on common ground with those agents as an exciting and modifying cause, since the latter increase and modify the mucous product by their direct action, while the increase of bile, urine, sweat, &c., depends upon reflected nervous action as the exciting cause (§ 222–233$\frac{4}{5}$, 461, 512, 647$\frac{1}{2}$).

If we now take an example, familiar as it may be in practice, it may help our philosophy as to all other combinations of remedies, and guide the practical hand in regulating the proportion of ingredients, the doses, &c. Thus, cathartics may become completely inoperative, as such, by the addition of opium. This is done by rendering the irritability of the intestinal mucous tissue so obtuse that it cannot be roused by the irritating virtue of the cathartic. Diminish the proportion of opium, and the cathartic irritates moderately and purges slightly. Reduce the narcotic still more, and the cathartic irritates more and purges more. Omit the opium, and the purgative effect may be violent and attended by great pain. And, in doing all this, we also variously modify the reflected nervous influences of all the agents which are thus employed (§ 227, 228, 500, &c., 872 *a*).*

This is an example for all other combinations of remedies; for the same philosophy is concerned throughout. We see, too, in this example, how the combination acts as a whole. The cathartic and narcotic simultaneously impress irritability and sensibility; each exerting its force upon those properties of life in the ratio of their proportions, and according, also, to the existing state of the properties (§ 137 *d*, 150, 189, 191, 872 *a*), and so will be the modified reflex nervous actions.

889, *l*. Cathartics are often cumulative in their effects; but this will depend much, as with numerous other remedies to which this principle applies, upon the frequency with which they are administered (§ 556–558). If the interval be short, as about four or six hours, and the same dose be continued, the last may operate with violence, although the preceding had manifested no effect. But this is far from being always true. Indeed, it is often necessary to increase the dose, even when exhibited at these short intervals; and we arrive at a knowledge of all this, and sufficient for the exigencies of the case, whether as to dose, the nature of the cathartic, or time for repetition, by considering the existing condition of the intestinal canal, or other contingent influences, such as jaundice, &c. But here, embarrassments frequently grow out of constitutional peculiarities of patients. These natural peculiarities, in relation to cathartics especially, are often remarkably great; one patient bearing far larger doses, and more active cathartics, than another under apparently the same circumstances of disease; just as in the case of bloodletting (§ 912). I am therefore always in the habit of interrogating patients with whose susceptibilities in this respect I am unacquainted, as to the quantity of salts, or of castor oil, they may be in the habit of using, with a view to their action upon the bowels. This enlightens us greatly as to their probable susceptibility to the action of other cathartics; and, with the object of extending the philosophy which concerns this subject, I will add that this knowledge as to cathartics will not help us with any other agent. Every other must be subjected to the same analysis.

* See NOTE EE p. 1133.

There is another and important modification of the cumulative effect of cathartics, according to the frequency of their repetition, and which may be said to apply, more or less, to most other remedies whose effects are cumulative (§ 555–558). We have just seen, that if cathartics be administered once in four or six hours, that effect is variously manifested. But, if the interval be much shorter, the cumulative influence will be more strongly pronounced. This is owing to the persistence of the modified state of intestinal irritability after each successive dose. Each dose, if soon repeated, raises irritability more and more, so that each, in succession, operates more and more. But, if the intervals be long, irritability returns to its natural state, and a larger dose will be necessary to make an impression (§ 137 *d*, 514 *g*, 516 *d*, no. 6, 549–558, 857). The principle now concerned explains the reason why tartarized antimony or ipecacuanha when united with the sulphate of zinc will take effect as soon as the latter. It is the same, too, which brings the permanent tonics into speedy operation when associated with the analogous diffusible stimulants (§ 890½, *g*).

Now, therefore, if the interval be quite short between the doses of a cathartic, their cumulative effect will be more and more strongly pronounced. Thus: if an infusion of senna, or a solution of salts, forming, respectively, one full dose, be taken in divided quantities every half hour, the entire quantity of either will often purge more actively than if the whole of either were taken at once. So, if a grain of ipecacuanha be administered once in four hours, it will generally fail of producing nausea; but if half a grain be exhibited once in two hours, it will be more apt to nauseate. There are peculiarities about tartarized antimony and other agents, in this respect, which have been considered under the designation of vital habit (§ 535, &c., 873).

A common principle applies to all the foregoing cases, is extensively ingrafted upon morbific and remedial agents, and of vast importance to the hand of art. In the cases recited, by the frequent repetition of the remedies we increase progressively the susceptibility of one part or another to their peculiar influences, either directly or by reflex nervous action. We bring the virtues of the different agents more and more into relation with the organic properties; and, when that relation is fully established, the last dose appears to exert, and may exert, a greater power than all that had preceded it.

889, *m*. We may now, perhaps, more readily comprehend a part of the philosophy which should govern us where it is mainly an object to remove habitual constipation, and to which a brief reference was made in a former section (§ 556, *b*). In cases of this nature, there are two primary objects to be kept in view: 1st. To avail ourselves of the cumulative effect of cathartic remedies; 2d. To establish a free secretion of bile, through alterative reflex nervous actions. To obtain these objects, it is obvious that the cathartic should be administered with a certain frequency, and that it should be of a certain kind. The cathartic should be of the best alterative nature, that it may reach the liver, and establish the most favorable change in the intestinal canal; the last of which has been already stated (§ 556, *b*). Castor oil is also valuable for this purpose (Paine's *Materia Medica*, p. 37). It is plain, also, that the doses should be so small as not to produce irritation; for this would soon result in positive disease. The most violent agent may be rendered mild by a proper regulation of the dose

It is therefore less the energy of the remedy, than its salutary alterative virtues, that is to be considered. In pursuing the treatment, our object should be to imitate Nature as nearly as possible: that is to say, to produce one free movement, daily, in the adult, and one or two in infants. The remedy, therefore, should be administered at least once in a day; or, if it can be rightly adjusted, evening and morning would be still better, at the beginning of the treatment. By this process we gradually alter the irritability of the intestine and bring it fully into relation with the virtues of the agent; and, as the bile possesses, also, cathartic endowments, we shall have thus adapted intestinal irritability to the action of that natural and now augmented stimulus. The case is parallel, in its philosophy, with that of the emetics and tonics, as stated in the preceding section 889, *l*. Also, § 516 *d*, no. 6.

It hence becomes manifest, that, by pursuing this course we shall soon be under the necessity of diminishing the dose with which the treatment was commenced; till, at last, the quantity dwindles away to such minute doses that the stimulus of the bile and the mechanical irritation of the alimentary matter supersede the farther use of the medicine; or, the minute doses may now become morbific.

It not unfrequently happens, that, at the beginning of the foregoing treatment the doses fail of their intended effect; when some other cathartic, as a little castor oil, or Rochelle salt, should be exhibited, but not enough to operate actively. Their active effect would interfere with the process of bringing the organic properties into a fixed relation with the small doses of the more alterative remedy, and subsequently to their natural stimulus, the bile.

In all this series of influences it is clear enough that a change is established in the condition of the liver; but a not less important one occurs in the vital state of the intestine (§ 1057 *c*).

889, *mm*. If we now regard, for a moment, the universal system which is pursued of administering active doses of cathartics, in the foregoing cases (§ 889, *m*), at intervals of two, three, or more days, we shall readily see that different results must follow; while experience teaches that constipation is not often surmounted in this manner. Too much violence is thus inflicted, nature is embarrassed, and is incapable of instituting those salutary changes which we have seen to arise in the former case.—See § 516 *d*, no. 6, 857.

Nor is it alone the intestine which fails of being diverted from its torpid state. A shock is propagated to the stomach; the liver violently impressed, and natural changes are not instituted in its action, and a continuous flow of increased bile is not established (§ 889, *a*).

It is readily seen that rhubarb, for the sake of its tonic virtue, may be often substituted for the aloetic and mercurial compound (§ 556, *b*), or associated with them, or ipecacuanha sometimes intermingled. Or, at other times, it may be greatly best to substitute mild enemas, whose action is explained in section 498, or again to depend upon diet, exercise, running especially, &c. But, a very common error is committed in these cases, as it respects food. It is not considered that the stomach often suffers as well as the intestine; and all the laxative food, as it is called, which is employed with a view of increasing the residuary matter, is apt to inflict a greater injury upon the stomach than any advantage that may arise from its mechanical irritation of the intestine. These are cases, therefore, for a very limited diet of those

things which are easy of digestion, and for the alterative treatment by medicine, exercise, &c.

889, *n*. And now as to the time, in a general sense, most appropriate for the exhibition of cathartics, and the philosophy which concerns it (§ 863, *d*). There is a certain attendant of the human constitution, as already seen (§ 768), which disposes the system to daily periodical excitement. This natural phenomenon takes place late in the after noon, in all parts of the globe. I have considered its application in a pathological sense, and it is of great importance in that double acceptation as it regards the operation of cathartics.

It is obvious, I say, that the system is in its most irritable and susceptible state toward the decline of the day, and that this period must be the worst for the operation of so powerful an irritant as cathartics, and more especially so if fever or inflammation be present (§ 137, *d*); though there is a great difference, in this respect, among different cathartics. The most appropriate time for their administration, in a general sense, is toward the decline of the natural evening paroxysm, or between ten o'clock at night, and eight o'clock in the morning. This will also generally bring their exhibition in febrile affections at an early stage of the remission of fever, so that their operation may be over before the access of another paroxysm. The same principle applies to inflammation; for, although there be no manifest exacerbation in the afternoon, the disease is under the natural tendency of the system to a sate of excitement at this period of the day.

At a late hour in the evening, the natural paroxysm is fast on the decline, and this is the most suitable hour for those cathartics whose operation is slow; as calomel, blue pill, aloes, &c.; and if other purgatives be afterward necessary, they may follow in the morning with a speedy effect. In this manner, the repose of the patient is not disturbed, and is conducive to the salutary influence of the highly-alterative cathartics. These cathartics exert powerful influences upon organs that may not be the seat of disease; which is particularly true of the skin. Now this action which is thus instituted in the surface transmits a curative reflex nervous influence to parts that are diseased, and both the impression upon the skin and its salutary reflex nervous actions will be much promoted by the warmth of the bed, by the horizontal posture, and by sleep. For the same reason, if cold should arrest the action in the skin which the cathartic institutes, that organ, suffering this violence, may reflect morbific sympathies upon other parts, and may thus, more or less, defeat the useful effects of the cathartic (§ 514, *h*).* It is the work, throughout, of reflex nervous action.

But, all cathartics whose operation is speedy should be exhibited at an early hour in the morning, when the irritability of the system is least, and sleep has had its balmy influences.

ASTRINGENTS.

890, *a*. Astringents are commonly supposed to act upon physical principles more than any other remedial agents, and that their special operation is analogous to the tanning process (§ 569, *b*). I shall endeavor, however, to show that Nature is so far consistent with herself, and that all the facts in the case enforce the conclusion, that astringents operate like all other remedial agents upon vital principles, whether they be administered internally, or applied to the external

* See NOTE D p. 1114.

surface; that they operate by so modifying the living properties and actions of the secerning vessels, that redundant secretions of blood, or of other fluids, are arrested in virtue of that change of vital action.

890, *b*. Let us now look for an illustration of the foregoing to some agent which embraces other virtues in connection with that which is reputedly astringent. There are many of these; such as the sulphate of zinc, the sulphate of copper, rhubarb, &c. We will take the last mentioned, for the sake of indicating, also, its uses in practice. This substance is positively cathartic in certain therapeutical doses, but so stimulating to the system in such doses as to render great caution necessary in its administration in acute inflammatory diseases; while, on the other hand, in much smaller doses it is adapted to many chronic inflammations. Again, in certain other small doses it is a valuable tonic, but still contra-indicated by active inflammation. Lastly, it may act as an astringent in various doses, from its smallest alterative, to its full cathartic dose; operating under particular circumstances of disease as a direct astringent in its small doses, as in diarrhœa, yet, in an opposite state of the bowels, as in constipation, proving an admirable laxative in the same small and repeated doses (§ 889, *m*, *mm*); while its wonders cease not even in its full cathartic dose—for now in diarrhœa it first operates as a cathartic, and then shuts up the bowels as an astringent.

Now, to what causes are all these diversified and apparently contradictory effects owing? They depend upon the natural susceptibility of the organic properties to changes according to the virtues of the agents which may act upon them, and their existing state when the agents are brought into operation; and, secondly, as well, also, upon the doses in which they are administered. When the vital conditions are affected in a peculiar way, and under a given combination of circumstances, if a vital agent possessing particular virtues be applied, it will so modify or alter the existing morbid state, that new and definite results will follow. Thus, when the intestinal mucous tissue is affected with that condition of disease which results in a preternatural watery secretion, and consequent evacuations, which is called diarrhœa, and rhubarb is administered in a certain dose, this substance first impresses the membrane in such a way as to determine an increase of the peristaltic movement; but it simultaneously alters the morbid state of the intestinal mucous tissue in such manner that the unnatural secretion is arrested; while the change which is thus established in the tissue removes the morbid reflex nervous action from the muscular tissue of the intestine, upon which the diarrhœal evacuation in part depended. The diarrhœa thus ceases after the rhubarb has acted moderately as a cathartic. The same causation which determined the action of the rhubarb as a cathartic changed the morbid state in such wise as to arrest the farther production of the intestinal fluid, and the preternatural determination of the nervous power upon the muscular coat of the bowels (§ 1062).—See NOTE EE p. 1133.

Whether, therefore, the rhubarb purge, or prove astringent, or tonic, a common principle and common laws are concerned throughout; and all the sensible results depend upon certain alterations which the agent effects in the vital properties and actions of the vessels, or tissues, which are the seat of the morbid conditions, or in which the various phenomena may take place.

Just so it is, also, with the sulphate of zinc, or of copper, or ipecacuanha, when they restrain hæmoptysis by their emetic effect, or when in smaller doses they arrest other hemorrhages, or diarrhœa, or at other times bring about the results of ordinary tonics. Consider, too, the special, but analogous, effects of opium; which, in arresting intestinal secretions, or those of the liver and kidneys, surpasses every astringent. And yet opium has no astringent principle, nor has it ever been supposed that this remedy checks those products by astringing the vessels or condensing the tissues. It arrests them, especially, by so modifying irritability and sensibility that the natural and other stimuli become less operative. And what lets us particularly into the philosophy of this subject is the coincidence in the effects of opium as it respects the simultaneous diminution of the various other products of the abdominal organs; the cause of the diminution of the bile, and of the urine, being the same as that of the diminution of the diarrhœal product of the intestine (§ 889 *k*, 891 *d*, 891½ *k*).

890, *bb*. What I have now explained comprehends the whole philosophy of the operation of astringents. When they arrest the discharge of ulcers, or of blood from the stomach, or of any part with which they come in direct contact, it is mostly by their direct action upon the vital condition of the parts. In other cases it is through reflex action of the nervous system. And here we may look at the coincidence in results between the application of an astringent to a suppurating surface and as the same discharge is arrested by a tonic, or by exercise, or change of air, &c. (§ 227, 740, 902 *m*). It is the change of action upon which the cessation of the various products depends, and this change may or may not be attended by a vital contraction of the secerning vessels, or of the vessels of any tissues upon which the agents may exert their direct effects.

Other remedies, such as loss of blood, and that one of a negative nature, cold, which often surpass the pure astringents in arresting effusions of blood, &c., may be brought to the same interpretation of the modus operandi of those astringents. And so the mind itself (§ 740 *a*).

890, *c*. When astringents are applied to outward surfaces, as to leech-bites, wounds, &c., they are called *styptics;* and in relation to those agents which are designed for the purpose of arresting external hemorrhages only, there are many which act mostly upon mechanical principles; either by pressure upon the bleeding vessels, as with lint, agaric, cobweb, &c., or by coagulating the blood which exudes from the part; while they also stimulate the bleeding vessels to contract.

890, *d*. Astringents are one of the classes of remedies which have been greatly abused, as well as applied with little reference to the pathological states they are designed to correct. Hemorrhage from every part, frequent discharges from the intestine, whether watery, bilious, or mucous, the discharge in gonorrhœa, leucorrhœa, &c., are treated by vast numbers according, alone, to the physical conceptions of the action of astringents; and those agents, therefore, are indiscriminately applied to all the foregoing conditions. Beyond this consideration, the discharge alone is an object of attention; the disease appearing to consist in this particular symptom. Many of the preternatural effusions depend upon inflammation or congestion, which astringents rarely fail to aggravate. And yet nothing is more common than the exhibition of those agents in these pathological conditions

without any antecedent treatment by other remedies. It is a common practice, for example, to exhibit the acetate of lead, or some other pure astringent, for a moderate hæmoptysis. The effusion, being instituted by nature for the relief of the congestive state of the lungs in which it originates (805, 1019), and violently arrested by the astringent, is counteracted in its great final cause. But astringents not only inflict that evil, but are also apt to increase the pulmonary affection by a direct morbific action; just as they increase dysenteric inflammation when they establish the change by which the redundant secretion of mucus is arrested. A very frequent ultimate consequence of the former untoward treatment is tuberculous phthisis. This practice has received a great impulse in recent times from morbid anatomy, especially as promulgated by Louis and Andral, and carried forward by British pathologists; who deny the dependence of tubercle upon inflammation. Nor can we desire a better proof of the importance of rendering all such pursuits entirely subservient to the demonstrations of living Nature (§ 756. Also, *Med. and Physiolog. Comm.*, vol. ii., p. 608–634, 743, 744, 748, 780–782, 799).—NOTE F p. 1114.

Instead, therefore, of the foregoing mal-practice, along with the simultaneous use of a stimulating diet, these patients, if the hemorrhage be small, should be treated by bloodletting, or small doses of tartarized antimony or ipecacuanha, blisters, &c. These agents arrest the effusion, and so far they exert the effect of astringents. But they do more. They alter the morbid states in a mode which Nature was attempting; while the real astringents alter them for the worse; though a cessation of the hemorrhage may be equally the result of either method of treatment (§ 150, 151, 732 *b*, 733 *e*, 862–864, 892$\frac{4}{5}$ *d*, *g*) *

There can be no sound practice till hemorrhagic effusions are recognized as the result of a secreting process, instituted by morbid states. The proof is abundant; but it is enough that we witness the consequent relief of disease, and apply ourselves to the analogy in this respect with what is known of redundant effusions of bile, of serum, &c., and which none can fail to recognize as salutary means employed by Nature. These hemorrhages, too, are analogous to menstruation, and here, as there, a great final cause lies at the foundation. There is, therefore, no more propriety in arresting hemorrhage, unless excessive, than in attempting to interfere with the natural function.

890, *e*. In the advanced stages of fever, and of other severe forms of disease, hemorrhages have been often followed by death. And here it is that hemorrhages have raised the greatest apprehension of their fatal tendency. But, it is very rare that it is the hemorrhage which destroys (§ 1019). It is only a symptom, at this advanced stage of the malady, significant of a fearful condition of disease, which, in itself, in a vast proportion of cases, is the true cause of death (§ 805, 863). The cause, therefore, is too apt to be mistaken, the blame too often attributed to a kind effort of Nature to throw off the deadly weight; and Nature would much oftener succeed by this depletory process were it not for the interference of art with its mischievous astringents. It is, however, always a fearful symptom in the advanced stages of acute disease. But, bad as it is, it should be hailed as the best possible event that can happen. The effusion comes directly from the congested parts, and if any thing can relieve them, it must be this spontaneous effort. Art cannot now interfere

* The record should be made that tonics and stimulants are now generally applied to this as to most other maladies.—NOTES F, EE, FF, GG, II, MM.—1865.

with bloodletting. The golden opportunity may have been allowed to pass, either from ignorance, or fear, or from the difficulties of the case (§ 569, 960, 964 *c*). Nature, alone, can now institute the great remedy; and here it is that we so often witness the safety with which she makes her wonderful demonstrations of cure, and rebukes the timid practitioner. But she has now her own way of operating. She has taken the business of rational treatment upon herself, and out of the hand of art; for now it is that quarts of blood may flow away from the intestine, and triumph over disease, when bloodletting would be perfectly useless, and the abstraction of a dozen ounces of blood would probably be fatal. These are lessons from Nature of every-day occurrence, and should not be lost even to such as are incapable of appreciating disease, or who may be imbued with prejudice, or haunted by fear, in respect to the great remedy whose timely application would save them from the consternation of witnessing a natural outpouring of blood, and from the mortification of discovering that there may have been an important error in treatment.

These are cases which require, in all respects, a great precision of treatment. Where Nature may have laid the foundation of cure by hemorrhagic effusions, a slight error in practice may be fatal. And here, again, the fault is apt to be laid at the door of Nature, and thus the disposition to interfere with astringents is more and more increased. Nevertheless, we should watch these effusions with vigilance; and, whenever they appear to be transcending the exigencies of the case, or the ability of the system to bear them, we should endeavor to restrain them by appropriate astringents (§ 805).*

890, *ee.* Those philosophers who justly refer capillary hemorrhage to a secretory process have distinguished the condition into active and passive; of which hæmoptysis is an example of the former, and that which was considered in the last preceding section, of the latter. But, this distinction is as clearly unfounded as that of active and passive inflammation (§ 752, &c.). Here, as there, the varieties are nearly on a par in respect to the pathological cause. The differences which exist among them are owing to only slight modifications of that essential cause. The modifications, however, are such as may require variations of treatment; one of them the antiphlogistic, another the antiphlogistic and astringent combined, and another the astringent alone. They are thus seen to run into each other, and they offer problems where it is the nicest point to determine whether we shall bleed and purge, or administer an astringent.

890, *f.* When hemorrhage supervenes upon chronic forms of disease, it commonly happens that it must be great to overthrow the obstinacy of habit; and the triumph of Nature is often thus displayed in the hæmatamesis which is set up by aggravated indigestion.

The hemorrhage attendant on tuberculous phthisis is a relief to the sufferer; but not often more than temporary. Nor can we now hope to do much by co-operating with Nature, any farther than to moderate the activity of disease by a non-stimulant diet, and blisters to the chest, or by general or local abstractions of blood where the quantity expectorated may be small. Astringents are always pernicious in these cases, unless the hemorrhage be excessive; and even then we shall generally fail to arrest the effusion on account of its connection with a serious lesion of organization. These, therefore, are cases

* Notes Ff p. 1135, Gg p. 1138, Ii p. 1139. Also, § 1019.

which sometimes prove suddenly fatal by the quantity of blood effused, or by its choking up the air-cells.—NOTE F p. 1114.

890, *g*. Cases of the foregoing nature (§ 890, *f*) appear now and then as consequences of badly-treated pneumonias, especially the congestive variety, or what is called typhoid pneumonia. But, we rarely witness any thing more than an expectoration of bloody mucus in the common form of the disease, or even in the congestive, if the treatment have been of the proper antiphlogistic nature.

890, *h*. Again, nothing is more extensively employed in the treatment of dysentery than rhubarb, and nothing more injuriously (§ 150). Its administration proceeds upon the erroneous views of the modus operandi of astringents and the want of a proper reference to the pathology of the disease. As that pathology consists in active inflammation, it should be manifest that rhubarb is one of the worst agents that can be devised; since it possesses not only the virtue of a true astringent, but is stimulant to the whole circulation, irritant to the whole mucous tract of the intestine, now morbidly susceptible throughout its length from the severe and specific inflammation of its inferior portion (§ 137 *d*, 398), and if the agent arrest the discharge, it is commonly by increasing and otherwise unfavorably modifying the inflammatory condition (§ 1062).—NOTE BBB p. 1148.

As in the foregoing case of hæmoptysis, therefore, we should have recourse to direct antiphlogistic means; and the cathartics employed should be of the least irritating nature, and then, only in cautious doses. But, they should be also of an alterative nature, and such as will reach the liver as well as the intestine. In a general sense, castor oil is the best (PAINE'S *Materia Medica*, p. 45). Also, § 1057 *l*.

If we now consider that ipecacuanha is the best internal remedy for dysentery, and the best for hæmoptysis, and that common table salt is one of the best for the latter affection, it will help us greatly to the knowledge we are seeking as to astringents, and lead to many practical advantages.—See *Ergot* § 892⅔ *o*; NOTE GG p. 1138.

890, *i*. Rhubarb, opium, and other agents which arrest redundant secretions, are often highly useful in some forms of diarrhœa, and sometimes in chronic discharges of mucus; but these products depend upon various pathological states, and whether astringent remedies will be useful or injurious will depend upon the precise nature of the disease (§ 150, 670–674, 733 *f*). In the simplest forms of diarrhœa they are more or less useful; particularly rhubarb, and that agent, chalk, which possesses no astringent virtue, but brings about the prominent result of an astringent merely by neutralizing some irritating acid. But soda or potass would not answer, since these irritate by their own virtues, and still more so by forming purgative salts within the alimentary canal. Saline cathartics are, therefore, also improper, and, moreover, scarcely extend their salutary permanent effects beyond the intestinal canal in cases where they are admissible (§ 1061).

890, *k*. But, even in the simple forms of diarrhœa, there is variety as to the exact nature of the morbid condition, which demands, in different cases, a choice of astringent remedies (§ 150, 672–674, 733 *f*, 863 *d*). One variety will be greatly benefited by rhubarb and chalk, but aggravated by opium. To another opium is exactly suited, as in pulmonary phthisis; and in such rhubarb may be detrimental, and pure astringents useless. To another variety, as in some old chronic

cases, the acetate of lead may be best adapted; and to others the pure astringents, such as kino, catechu, geranium, &c., when all other means which I have indicated would be either useless or injurious.

890, *l*. The foregoing examples illustrate variously the general principles which are propounded in this work. But, the variety of illustration may be greatly extended in respect to the remedies now before us. It often happens, for example, that frequent watery discharges are owing either to inflammation of the intestinal mucous tissue, or to a state approaching inflammation; as in cholera infantum. Here, all astringents are inadmissible; and, if the case be cholera infantum, such is the peculiar nature of its predisposing causes (§ 650-653), that there is nothing comparable with the mild chloride of mercury in doses varying from the twentieth to the eighth of a grain, once in four to twelve hours; perhaps, also, with a little chalk and the camphorated tincture of opium along, to neutralize an acid and to allay intestinal irritability. But it is the mercurial agent which does the work, by breaking up the morbid condition. Calomel, therefore, in such cases, is just as much an astringent as alum, or the acetate of lead, or catechu, in other cases of a modified pathology (§ 150, 151, 863 *d*). Will Chemistry explain (§ 892 *b*)?

890, *m*. Gonorrhœa is another example, and another form of inflammatory disease, where great suffering, and prolonged sickness, are induced by the want of a proper knowledge of the operation of astringents, and a proper discrimination as to the particular state of the pathological condition when the remedies are applied (§ 672). The preternatural discharge is apt, indeed, to be regarded as the disease; or whether so or not, it is a common practice to resort, at once, to astringent remedies, internally and by injections. Such, however, is the force of inflammation, and morbid irritability so strongly pronounced, that a direct antiphlogistic treatment should be at least premised; when, also, it will be commonly found that it has superseded the necessity of astringents. And here, again, we may remark how the coincidence in effects between the internal use of copaiba, or cubebs, and injections of an astringent nature, denotes a common mode of action, and places the whole upon vital ground. The frequent salutary effect of the nitrate of silver when employed as an injection in the early stage of gonorrhœa, and its pre-eminent advantages in leucorrhœa, go to confirm the same philosophy (§ 150, 151). This substance has no astringency, in the proper acceptation, but operates in its own wonderful way in breaking up the inflammatory state upon which the discharge depends.

890, *n*. And then as to leucorrhœa. How badly is this affection often treated by astringents, internally and externally, and also by tonics! And all this, mainly, because the disease happens to have, for one of its symptoms, a discharge from the vagina, and is supposed to depend upon debility of the general system, and relaxation of the mucous tissue; a sort of mechanical exudation from a flabby membrane that tonics and astringents may condense and strengthen (§ 409 *i*, 410, 569). But, if we look at the inflammatory nature of this affection, there will be no difficulty in understanding how these agents, and the usual stimulating diet, inflict their injuries. And now, if we consider that cantharides is the best internal remedy for leucorrhœa, another luminous guide will be obtained to a right apprehension of

the mode in which astringents may check, for awhile, those discharges which they may ultimately increase, or others, in other cases, successfully and permanently.

890, *o*. Let us now consider the remarkable manner in which certain agents will arrest a copious excretion of sweat, and we shall learn still more distinctly that astringents operate through reflex nervous actions; and thus be guided to the only intelligible purposes for which they should be employed, and carry this knowledge throughout the breadth of the Materia Medica.

Thus, then; here is a patient affected with pulmonary phthisis, who rises in the night to shift his wet for dry linen. But this inconvenience may be stopped at once by a few drops of sulphuric acid; and opium will often do the same. The acid and the opium, however, produce very different impressions; though each arrests the sweating by certain vital influences. One may be beneficial, while the other is injurious, and vice versa, according to the exact combination of pathological circumstances when the agents are administered. In other diseases, and where the skin is dry, opium will induce perspiration; and it accomplishes this through the same laws as when it arrests the excretion. And, if we now observe the apparently contradictory philosophy when opium simultaneously checks the products of the liver and kidneys and increases that of the skin, we gain yet farther light as to astringents, penetrate to the common laws which are distinguished by opposite results, and go to the work of cure as the mechanic when he elicits countervailing movements from a common principle, or a common power, whose attributes are known (§ 863, *d*).

The vegetable kingdom supplies many astringents from which a substance is derived under the name of *tannin;* and hence, in part, the physical rationale of their modus operandi upon living beings. It is supposed that their astringent virtue resides in this tannin; and this may be so where the principle may be elaborated. But, there are numerous substances of active astringent virtues from which nothing analogous to tannin can be derived; such as the acetate of lead, and, indeed, all the mineral substances belonging to the group of astringents. We see, therefore, that the effect of the astringents themselves is not due to any coincidence in the constitution of these substances; and yet, notwithstanding the great differences among them, they may all bring about a common result (§ 150, 892 *b*, 892½ *v*).

It is not alone to certain pathological states that result in redundant effusion that astringents are applicable. Certain conditions of inflammation, especially of external surfaces, are often greatly relieved by their local action. Acetate of lead is one of the best remedies, externally applied, for inflammation of the skin, of the eyes, &c. Sulphate of zinc, also, for conjunctivitis, the mineral acids or vegetable astringents for inflammation of the tonsils. These are active astringents, and the variety in their effects, according to the nature of the pathological conditions, whether employed internally or externally, declare their physiological action, and call upon the practitioner to study well the capabilities of each one. Nay, more; their variety of action when applied externally is not less than what we have seen from their internal administration. The acetate of lead, for example, may speedily relieve certain conjunctival inflammations, when such modifications of inflammation would be greatly aggravated by the sulphate of zinc;

but, in another case apparently alike, the sulphate of zinc will answer a better purpose. The nitrate of silver, however, or blisters, or leeches, may be well adapted to all the modifications. But here is a case, apparently the same, in which all the foregoing means have failed entirely. On pushing inquiry, however, we learn that in the generation preceding the last there prevailed the scrofulous diathesis. We accordingly resort to iodine, and the inflammation yields as under the influence of some magic power (§ 137 *e*, 150, 151, 851 *b*, 863 *d*).

Now, it is of vast practical importance to consider that the foregoing differences in results depend mostly upon slight shades of difference in the inflammatory states in the several cases (§ 150, 662, 673). And who can mistake the common nature of the modus operandi of all the agents employed (§ 137, *e*)?

890, *p*. It is important, therefore, to understand that no two astringents are exactly alike in their effects, and that the property which is recognized as such may be associated with other active virtues in the same substance, by which the astringent is variously modified; while, as in compound medicines, the several virtues act as a whole, that which is most predominant giving the greatest determination to the nature of the impressions that may be produced (§ 188½ *d*, 889 *k*, 892). This variety, it appears, adapts these agents very variously to different forms of disease. When, therefore, a pure astringent is only required, such as may possess tonic or stimulant virtues should, obviously, be avoided. Remarkable examples of this nature, associated also with other virtues, occur in rhubarb, cinchona, the muriated tincture of iron, &c. Hence there is a great range of choice among remedies which may be selected to answer the intention of an astringent, in its strict acceptation. This has been already variously illustrated, as in the example of rhubarb. But we will have an exemplification in the Peruvian bark, an infusion of which, on account of its specific febrifuge virtue, would be exactly adapted to diarrhœa attendant on intermittent fever; or quinine, perhaps, would be preferable if the disease be recent. In such cases a pure astringent would be useless; which farther illustrates the operation of astringents, as it does, also, the distinctions between tonic, astringent, and febrifuge virtues.

But, the foregoing are broad shades of difference in pathological conditions. In very many cases where there is a great approximation in the pathological states, in many modifications of inflammation, it is often important to apply a certain remedy of astringent virtue in preference to others.

890, *q*. We may now see that certain astringents may be best suited to certain organs to which they are addressed than to other parts (§ 133, &c., 140, 150).

But these agents are so much circumscribed in their uses, that it is no longer an object to pursue the inquiry. What has been said is more with a reference to bring these remedies within the pale of medical philosophy, and to illustrate that philosophy; and, in so doing, to prevent their misapplication. Those which are associated with other virtues are mostly wanted; such as rhubarb, cinchona, the sulphates of zinc and copper, &c., and these, mainly, for the sake of those virtues.

PERMANENT TONICS, AND DIFFUSIBLE STIMULANTS.

890½, *a*. Tonics may be regarded as a counterpart of the antiphlogistics. From the circumstance, therefore, of the latter occupying the high places in the materia medica we may come, at once, to the conclusion that the former are comparatively of very limited importance. Indeed, it is only in the advanced, or in the declining stages, of acute diseases, or in certain states of chronic affections, that tonics can render much service.—NOTE Ee p. 1133.

No remedial agents, however, have been more extensively employed, and therefore none which have been so extensively injurious (§ 569, *e*). This misapplication of the Materia Medica has arisen, as in other ca ses, from erroneous theoretical views of disease, and mistaken notions of the modus operandi of remedies (§ 854 *bb*, 863 *d*, 892 *b*, 904 *d*).

890½, *b*. In considering the uses of tonics it should be borne in mind that they have but a very limited range of curative influences; and that, in a general sense, they do but invigorate organic actions which have been reduced by prolonged disease, and where there is either no great amount of absolute disease, or where nature is already in the way of the restorative process, or where that process may only require an invigorating impulse to start it into existence. Such are the uses of tonics.—NOTE F p. 1114.

By now regarding the true mode in which these intentions are ac complished, and the absolute influences which are exerted by tonics, we shall come to a just apprehension of their relations to morbid states, and be better qualified to avoid them where they may be injurious.

890½, *c*. Tonics are commonly supposed to act upon mechanical principles, by bringing into close apposition the molecules of which the living tissues are composed, and attempts have been lately made, as at former times, to demonstrate the truth of this conjecture by experiments upon dead tissues (§ 569, *b*). This has led many to confound the virtues of tonics with those of astringents. But, we shall find that here, as in all other cases, Nature is consistent, and that tonics bring about their results like other remedial agents; that here, as in all analogous instances, there is no departure from Unity of Design (§ 137, *e*). A few plain illustrations will place the operation of tonics in its proper aspect.

890½, *d*. Thus: on referring to an example already stated for another purpose, we cannot fail to observe that the increased warmth of the skin, and muscular vigor produced by animal food as soon as it enters the stomach, are due to the same causation as the analogous effect of alcoholic stimulants, and that both must be expounded upon vital principles (§ 512, *b*). Those speedy effects manifestly depend upon vital impressions exerted upon the mucous tissue of the stomach, and their transmission by reflex nervous action to other parts. They are variously pronounced according to the exact combination of circumstances. The food will display itself most distinctly in such as have suffered its privation, and where the surface is chilled; the wine where it is least employed (§ 535, &c.). By varying these incidental influences a corresponding variety will obtain in the results. Employ the food or the wine in febrile and inflammatory states and the same manifestations take their rank among the violent phenomena of disease. Now, here is the whole principle which is relative to the action of

tonics. These agents produce the same effects as the foregoing causes. They are the same, or sufficiently so for my present purpose, in the natural state of the body, and are modified in the same manner when employed in fever and inflammation. The fatigue incident to hard labor is instantly relieved by nourishment or by wine. The influences here are exactly analogous to the vigor which is imparted to the voluntary muscles by tonics in cases of indigestion. In the former case the powers of the stomach and the animal frame have sunk under fatigue (§ 855); in the latter from disease. The food and the wine in one case exalt those conditions; and, from the analogy in the influences which are established by tonics in the other, we know that a common mode of action has obtained throughout (§ 137 *e*, 151). But, the tonic goes yet farther, and brings about a change in the organic state of the stomach, since food will not remove the condition upon which its indigestion depends. The tonic, therefore, is an alterative stimulant. In all the cases the voluntary muscles are suddenly or gradually invigorated by reflex nervous actions propagated from the stomach. It is the same with the tonic as with the food or the wine. No sooner has the dyspeptic swallowed the first dose of bark than he tells us that his strength is coming as by enchantment. The tonic, also, like the wine, increases the desire for food; and if this effect can be no more interpreted by the physical doctrine than the former results, it may be safely concluded that every other problem offered by tonics falls within the philosophy of vitalism (§ 500, 516 *d*, no. 6, 350, no. 94).

It is now an easy matter to institute analogical demonstrations of the physiological operation of tonics, as in former cases, that of astringents, for example (§ 890). For this purpose ipecacuanha and the nitrate of silver may be taken; neither of which has any tonic virtue, while the former is contra-stimulant. But these agents are appropriate to the same states of indigestion as the tonics, and bring about the same results (§ 904, *d*). Or, take a mental cause for an exactly similar parallel, which may be seen in the effects of some agreeable intelligence, which, no one can mistake, has imparted, on the instant, a keenness of appetite, a vigor of digestion, and an exaltation of muscular strength, which had not been enjoyed for a month or a year (§ 137 *e*, 227, 512, 514 *h*). Or, place the same individual on board a vessel, or give him an airing by land, and the first hour, perhaps, will have brought with it far greater improvement of digestion and of muscular strength, than would have been imparted by cinchona, or any other tonic, in a month (§ 150, 657 *a*, 847 *g*, 856 *a*).

890½, *e*. As to the extent in which tonics may act as alteratives that, as in respect to all other remedial agents, will depend upon the departure of the organic properties and actions from their natural type. As in all other cases, also, the useful effects will depend upon the nature of the morbid changes. But these conditions, in their relation to tonics, are not often constituted by any great deviations from the natural states. In most other instances tonics are morbific (§ 137, *e*). If they happen to be useful in active forms of disease, it is a random hit (§ 756). Their operation, however, even then, comes under the same principle as when they produce favorable results upon chronic derangements (§ 901). Sometimes, therefore, when active disease becomes prolonged, and the susceptibilities of the parts affected turned a little from the incipient pathological state and under the influ-

ence of vital habit, tonics will prove less frequently detrimental, or may be so far curative that we venture to associate them now and then with the direct antiphlogistics, to obtain their mixed influence. It is often useful to combine them, especially the vegetable, in the form of infusion, or, perhaps, of tincture, with the mild cathartics that are adapted to the advanced stages of disease, just as we have seen of the union of rhubarb with saline purgatives (§ 872, *a*). In such cases, they not only prevent any prostrating effects of the cathartic, but are positively remedial by going to the vital condition of organs (§ 137 *d*, 150, 569 *c*). And here, as in the case of rhubarb (§ 872, *a*), we may reverse the order of indications, and suppose that a tonic may be useful if it can be prevented from stimulating injuriously. This object may be often attained by uniting a mild saline cathartic, or, administering small alterative doses of tartarized antimony. This practice, in respect to antimony, is often highly useful in the treatment of intermittent fever, where the tonic virtue of cinchona, or quinia, interferes with the febrifuge virtue; while, at the same time, the antimony does its important work as an antiphlogistic alterative. Both of the agents, in these cases, are principal remedies. But it is the febrifuge, not the tonic virtue, which makes the salutary impression. The former is positively morbific, and may not only defeat the febrifuge action without the counteracting influence of antimony, but aggravate greatly the whole condition of disease. And this, by the way, is a distinct exemplification of the existence of those two opposing virtues in cinchona; while in the other forms of disease it shows itself in the aspect only of one of the best tonics (§ 137 *d*, 150, 535, &c., 672, 673, 675, 756, 847 *g*, 848, 854, 863 *d*, 867, 889 *k*, 890 *b*).

890½, *f*. But I say, again, that these agents are never wanted, in their relation to diseased states as tonics, in the early stages of any disease whatever; and, however they may now and then succeed (§ 756), they are generally prejudicial. If employed in certain forms of fever or inflammation in which tonics possessing febrifuge virtues, like cinchona, are not indicated, they endanger life (§ 150, 569 *e*, 621 *a*, 652 *c*, 662, 847 *g*, 848, 863 *d*). I think I shall have justified this assertion throughout the extent of these Institutes. But, in failure of this I have only to point out the results of the Brunonian doctrine of disease, which prompted the tonic and stimulant treatment to so great an extent that it has been computed to have destroyed a greater number of the inhabitants of Europe, in the first forty years of its prevalence, than all the wars of that sanguinary period (§ 621, *a*, 1068).

890½, *g*. There are great resemblances between the virtues of tonics and diffusible stimulants, in their common acceptation; but there are also important distinctions. In instituting comparisons, therefore, between them, or of all other remedies, they should be regarded in their just relations to morbid states; for in this adaptation alone can they be remedial. We shall thus find that both classes of remedies are more or less applicable to the same conditions of disease, and that, on account of the differences that exist in their remedial virtues, it will be often useful to combine them together (§ 863 *d*, 889 *k*, *l*). In their proper therapeutical acceptation, tonics make their impression much more gradually, and more permanently, than diffusible stimulants; observing, in this respect, the same distinction that subsists between animal and vegetable food (§ 441 *c*, 890½ *d*). When, also,

tonics are useful, their effects are far more profound than those of diffusible stimulants. But this is not true of their morbific effects under circumstances of existing disease; since wine, and especially more ardent spirits, taken in any acute inflammation or fever, not only produce their usual more rapid impressions, but exasperate the morbid states to far greater degrees of intensity than any of the permanent tonics. The principle holds, also, in chronic diseases when tonics or stimulants prove morbific (§ 137, *d*).

The foregoing peculiarity of tonics fits them admirably to certain chronic forms of disease where the strong influence of a long-protracted morbid habit is to be surmounted (§ 535, &c.). Stimulants will not reach these conditions with sufficient alterative effect, or they may act with too much rapidity where a diseased habit is obstinately established, and where long-continued organic actions of a morbid nature can be surmounted only by the slow operation of favorable causes. But, in these obstinate conditions the permanent tonics may not act with all the rapidity that may be useful; and then we associate some of the transient stimulants with them, by which the morbid states are rendered more susceptible of the effect of the tonic remedy, just as by uniting the sulphate of zinc with ipecacuanha the latter will exert its emetic effect simultaneously with the former; all of which contradicts the doctrine of absorption (§ 137 *d*, 889 *k*, *l*, 904 *bb*).

Again, however, some of the tonics possess, also, the virtues of transient stimulants, such as the cinchonas; and these compound attributes suit them well for those conditions of which I was last speaking, or for irritable states of the stomach when tonics are wanted, but are apt to nauseate (§ 150, 889 *k*, 890 *b*). In these conditions, a cold infusion of cinchona, whether as a febrifuge or as a tonic, surpasses its alkaloids on account of the presence of a volatile oil by which the stomach is promptly and gently stimulated, and thus enabled to bear the tonic influence of the bark.

890½, *h*. The suggestions which have been now made let us at once into the reason why all the tonics and stimulants may be converted to useful purposes in disease, and why it is greatly otherwise with cathartics and emetics. In the last instances there are far greater diversities in their curative and morbific virtues, and they are far more of an alterative nature than such as appertain to tonics and stimulants. There exist, indeed, among cathartics and emetics many agents that can rarely be applied to any morbid conditions without increasing the existing evil or engendering new ones. In this respect, all the tonics and stimulants, when employed in active febrile or inflammatory states, are on a par with the most irritating cathartics and emetics. Their effect then goes deep; which admonishes us, more and more, to study well the relations of remedies to diseased conditions, and to discard all the conclusions which have been drawn from an observation of their effects upon man in health (§ 137 *d*, 150, 662 *a*, 675, 854 *bb*).

Nevertheless, the same principle of diversity applies to the several members of the classes of tonics and stimulants; but it reaches them in a very inferior degree (§ 52, 650). Since, therefore, there are no groups of remedies so closely allied in their virtues throughout as tonics and stimulants, there are none which, throughout, bring about results in the treatment of disease that so closely resemble each other (§ 863, *d*).—Note Ee p. 1132.

We thus come to understand why all the substances which compose the classes of tonics and stimulants may be more or less useful, and that no one of them is an excrescence upon the Materia Medica; notwithstanding the vast abuses to which they have been subjected, and the immense mortality of which they have been the conspicuous causes (§ 569 *e*, 621 *a*). We are also thus led to the knowledge that one tonic, or stimulant, will often answer a better purpose than another; and we find, on applying ourselves to an observation of Nature, that experience confirms all the other premises. We have just seen an example of this in cinchona, and it is a striking general distinction, that the vegetable tonics are best adapted to the prostrate conditions which follow long-protracted acute diseases, while the mineral, especially the preparations of iron, are suited to chronic maladies, such as indigestion. Here, however, the vegetable tonics may be equally appropriate, while the mineral ones are not so to the direct sequelæ of acute maladies.

NARCOTICS.

891, *a*. Narcotics are agents which affect, especially, the nervous centres, and are, therefore, also denominated *cerebro-spinants*.*

In my *Arrangement of the Materia Medica* I have divided them into six groups or orders, according to their special influences upon the nervous system. Narcotics stand in a group by themselves; and the remaining five consist of *antispasmodics*, *tetanics* or *cerebro-spino-excitants*, *moto-paralysants*, *senso-paralysants*, and *cerebro-spino-depressants*. These distinctions are more or less observed by others.

Some of the narcotics, however, possess also the virtues of other groups, and vice versa; and, therefore, in conformity with this compound endowment, the same agents appear under the several appropriate denominations.—Note Nn p. 1141.

891, *b*. The most useful of the narcotics are the great agents by which pain is immediately assuaged, restlessness subdued into tranquillity, and wakefulness converted into refreshing sleep. Such, therefore, may be taken as the definition which I apply to narcotics, and without special reference to the profound influences which they may exert upon organic functions, or to other useful effects.

But, all narcotics do not equally produce their several effects. Some of them are more remarkable for diminishing and relieving pain, and are called *anodynes* (§ 194, &c.). Others produce sleep more particularly, and are known as *soporifics*. Others allay irritability and diminish vascular action, local and general, in a more decided manner than the rest, and are called *sedatives* (§ 188, &c.).

Such are the denominations in common use; but they are somewhat defective. All the soporifics, for instance, are also anodynes, and most, though not all of the anodynes, are more or less soporific. There are, also, many sedatives which do not rank at all among the narcotics; to which, indeed, the most powerful do not belong, such as bloodletting, hydrocyanic acid, tobacco, &c., and of which bloodletting is the only one of much value in the treatment of disease, but that one emphatically and justly denominated the *remedium principale*. The sedatives, therefore, which fall under the denomination of narcotics, possess, also, anodyne or soporific virtues.

891, *c*. We have seen how extensively large classes of remedies

* This term is deficient in not embracing the sympathetic nerve, which is mainly interested in the nervous influences upon organic functions and products (§ 113, 461½).

have been perverted in their uses, and have yet to consider the no less common neglect or misapplication of bloodletting. There is no other way of enforcing their claims to a just consideration. In respect to the agents now before us, there is a yet smaller class who are equally unhappy in their estimate of their virtues; and, while the *stimulating* school exhaust the energies of Nature by adding to the intensity of disease in their peculiar way, the *narcotizing* school do the same mischief by a similar neglect of the pathology of disease; and what in either case should be attacked by the lancet, cathartics, antiphlogistic alteratives, &c., is roused into greater immediate violence by tonics and stimulants, or indirectly by other morbific influences which appertain to the narcotics (§ 150, 151). Take, for example, the opinion of the able and distinguished London physician, Dr. Sigmond, who says that,

"*Of all the different classes of medicine we possess, we may fairly consider the narcotics, skillfully, judiciously, and watchfully administered, the most important.*"—SIGMOND'S *Lectures in London Lancet*, 1836–7, p. 216.—And so, also, *Pereira*, § 960, *a*, p. 718.

The foregoing affirmation shuts out, of course, bloodletting, cathartics, all the important and numerous agents which I have grouped under the denomination of alteratives, as inferior, in therapeutics, to opium, hyoscyamus, &c. (§ 854 *bb*, 857).—NOTE H p. 1117.

On the contrary, I shall have endeavored to show, in various parts of this work, that narcotics are but little more than humble auxiliaries to more important remedies, and then only in a comparatively small number of the cases of disease; or, that they are mere palliatives, giving a temporary ease by blunting sensibility, where death is probably inevitable, and thus easing the sufferer out of existence.

891, *d*. That narcotics are extremely deficient in curative virtues should be sufficiently apparent from what has been already said of the uses to which they are constantly applied. But, even these intentions can be rarely well fulfilled by narcotics where much disease is present. We must then resort to the class of antiphlogistics for our great curative means; and, if the narcotics be summoned to their aid, it should be done with the greatest caution, or they may prove fatally morbific. We may exhibit opium, &c., for the relief of mere spasm of the stomach, to procure rest, &c., where no important acute disease is present. But he who should employ them to assuage the pain of pleuritis, enteritis, or any other active form of inflammation, and, in a general sense, of chronic forms, would either most seriously aggravate the disease, or destroy the patient (§ 150, 151).* Whenever, also, there is any affection of the head, or any tendency to cerebral disease, so great is the liability of narcotics to induce congestion of the brain, that they are totally inadmissible where that organ is increased in its susceptibilities (§ 137, *d*). And then let us consider their never-failing effect, in their ordinary doses of so injuriously modifying the action of the glandular organs, that the secretions of the whole, especially of that most important organ the liver, are more or less diminished; whereby Nature is obstructed in one of her greatest processes, natural and curative, and morbific nervous actions reflected upon all diseased parts, and upon the whole organism (§ 862, 863). Should this nervous influence excite in the skin a perspirable action, it is not of a salubrious nature; and here, again, we see demon-

* There would be as much propriety in treating pleuritis as peritonitis by the enormous doses of morphia now in vogue for the latter affection.—1860.—NOTE H p. 1117.

strated the evils that arise from regarding the product and not the nature of the action upon which it depends (§ 512 *b*, 863 *d*, 902 *g*). Hence has arisen the pernicious custom of depending upon the compound powder of ipecacuanha as a principal curative means in the treatment of fever. The opium determines morbific nervous actions upon the glandular organs and nervous system; being scarcely modified for the better through its union with ipecacuanha, even in its greater diaphoretic influence upon the nervous power.

891, *e*. In respect to the modus operandi of narcotics, I shall now only lay down the proposition that these agents produce their salutary or their morbific effects like all other remedies, or all other causes of disease, and set forth the proof in other appropriate places (§ 891½ *k*, 904, &c.). The principle involved is so perfectly in harmony with all physiological facts relative to the healthy state of the body, and supported by all the well-ascertained facts in medicine, that it enables us to comprehend how it is that ten drops of the tincture of opium administered by the stomach will afford more relief to one man than fifty drops will to another, or how the ten drops of laudanum may do more injury in the former case, than fifty will in the latter, where the conditions of disease are exactly alike, but where the doctrine which I have advanced expounds the difference in effects upon natural physiological differences and other attendant peculiarities, and, as for the rest, by the production of a sedative reflex nervous action corresponding with the existing susceptibilities (§ 227, 447, 891½ *g*, *k*, 904).

The failure of narcotics to produce the same effects when applied to the trunk of a nerve as upon its expanded extremities is a prominent fact in humoralism, and has contributed largely to the doctrine of remedial effect by absorption. The fallacy of the whole philosophy is indicated in other places (§ 826, *d*, &c.).

891, *f*. The effects of narcotics generally decrease, respectively, when frequently repeated, or when habitually employed at more distant intervals (§ 558, *a*). But the organic properties, as in their relation to all vital stimuli, whether remedial or morbific, maintain about their usual susceptibility to all narcotics except the one in use; and it is therefore often advantageous to change from one to another, or to employ two or more in combination (§ 150, 151, 650, 889 *k*). And here I may remark how a single fact proves that remedies operate upon the system at large by reflex actions of the nervous system.

We have hitherto seen that an admirable variety of virtues appertains to many of the different members of each group of remedies, by which they are extensively adapted to various pathological conditions that approximate each other, but which are marked by such differences that, were each group composed of only one or two agents, we should be constantly baffled in the treatment of disease (§ 889, *k*). And, how vastly, in this respect, has the Materia Medica been improved in recent times by simplifying certain substances of compound virtues, attended, also, with much excrementitious matter; as in the examples of many alkaloids, iodine, &c.! Opium, for instance, is generally inadmissible in inflammations, unless to moderate irritability of the intestine in muco-enteritis, or of the lungs in pneumonia, or after the disease as affecting some other parts shall have been subdued by bloodletting, cathartics, &c. But morphia may be very appropriate when opium itself would be detrimental (§ 863, *d*). If nei

ther, however, be admissible, we possess in hyoscyamus, or conium, or lactucarium, or lupulin, or churrus, &c., substitutes which may be often employed with advantage. So, again, belladonna, aconite, stramonium, render, each one, their peculiar services in certain painful affections, or other conditions of disease, or subserve some purpose in surgery. As these last three, however, possess no soporific virtue, but lead to sleep by assuaging pain and irritability, they are included in my arrangement under the denomination of *senso-paralysants*.

891, *g*. The most extensively useful effect of narcotics is that of procuring sleep; so great is the tendency to wakefulness in diseases, and so pernicious is its presence. This, too, depends greatly upon age; children requiring a great amount of sleep, while four or six hours will commonly answer for manhood and more advanced age. This is for disease. Rather more than the maximum is wanted in health. The law of adaptation comes, here, into operation, in morbid states, as with all things else (§ 137, 847 *g*, 848, 859, 863 *d*, 870 *aa*).

But, before the administration of narcotics for the purpose of procuring sleep, we should look well to the cause of the wakefulness; for the loss of blood, or a cathartic, or an emetic, or greater abstinence from food, &c., may be the appropriate means. When, however, narcotics are adapted their effect is peculiarly happy, not only in relieving and aiding Nature, but in promoting the operation of other remedies (§ 137 *d*, 150).

891, *h*. We are often required to witness an obstinate wakefulness arising more from anxiety, or other affections of the mind, than from the disease itself; and when the day comes, the first glance of the eye upon the sunken or ghastly features of the patient may awaken apprehensions for which there is no just foundation. Now let the window-shutters be closed, exclude all unnecessary attendants, let the nurse be seated quietly in a chair, lay aside medicine and even food, take down the bed-curtains, ventilate the room, but not from a window that may throw a blast upon the patient, graduate the bed-clothes to his sensations, moderate or put out the fire, and if the patient have not rested when night comes on again, give him a suitable narcotic, keep all things quiet, and, at our morning call, we shall be likely to understand the reason why narcotics are so improperly administered when wakefulness arises from profound disease, perhaps of the brain, or when sleep is ample, but pain and suffering call for a relief that narcotics may not yield. It is the delightful effect of these agents, in the case which I have just supposed, and where preliminary means for tranquilizing the system have been adopted, that often leads the inattentive observer of the pathology of disease to their indiscriminate use; and his blindness is frequently such, and so great may be the quiet and insensibility which the narcotics produce, that the patient may drop into the grave without raising the suspicion that he was doomed by the treacherous remedy.

What I have just said of quiet, darkness, &c., are exceedingly important auxiliaries to soporifics, and should be carefully directed. They are causes, too, which should awaken attention to the modus operandi of active remedies, whereby the necessity of the latter will be greatly diminished. Choose, also, the night, when possible, for the exhibition of soporifics; not only on account of its greater stillness than the day, but because this is the natural time for sleep (§ 137, *e*).

891, *i*. The next great use of narcotics, in an absolute remedial sense, relates to their power of diminishing the *irritability* of disease; whether local or general, and thus aiding nature (§ 188, 905 *b*).

Irritability is augmented in inflammations, and it may be important to allay it by narcotics; not only to enable Nature to take on the cure, but to prevent the undue action of exciting causes (§ 137 *d*, 150, 645 *c*, 855). Thus, it may be very useful to exhibit morphia in pneumonia, after bloodletting; by which the cough may be more immediately assuaged than by the loss of blood. But narcotic means are more admissible, and far more useful in inflammations of the intestinal mucous tissue than of any other organ. Here, too, in various states of the alimentary canal, narcotics may often precede advantageously the administration of cathartics, or be associated with them; and, in a general sense, hyoscyamus is by far the best. In this case we lessen the irritability of the intestinal mucous tissue, and thus prevent the cathartic from doing mischief to the part (§ 889, *k*). So, also, in dysentery opiates are often given to allay the irritability of the part inflamed; even when no other internal remedy may be employed. Or, it may be to prevent any irritation from small doses of ipecacuanha, or calomel, &c. But when opiates are employed in such affections, the doses should be small, and repeated if necessary. Larger ones prove morbific. In serous inflammation of the bowels, on the other hand, they are entirely inadmissible (§ 137, *b*, &c.). But, it not unfrequently happens, that active inflammation seated in some circumscribed part of the intestinal mucous tissue induces spasmodic action in the contiguous muscular portion, which cathartics never fail to aggravate. In these cases a moderate dose of opium may relieve the spasm, and result in free dejections, by imparting a *sedative* influence to that reflex nervous action which occasions the spasm (§ 891½ *k*).

Nevertheless, opium should be always cautiously exhibited in all cases of the foregoing nature; but, with this reservation, they are likely to prove highly salutary in very many instances. But it is in all such instances only a subordinate agent; and it will be often far better to accomplish our purpose of obviating the apprehended bad effects of a cathartic, or any other remedy that may be likely to irritate the intestinal mucous tissue, by the general or local abstraction of blood, or by vesicating the abdomen (§ 890 *b*, 1058 *f*).—Note Gg.

It should be now said that puerperal peritonitis is sometimes treated successfully by opium given to full *narcotization*, though recovery is then as slow as seldom. The same has been more doubtfully affirmed of intestinal peritonitis. Irritability is so thoroughly subdued in the successful cases that it ceases to be morbidly excited by the blood, and the inflammation yields in consequence. Greater exceptions may be seen in § 756. The practice is empyrical (§ 1005 *a–g*).—Notes E H.

891, *k*. Next in order comes *pain*, depending on exalted or morbid sensibility. This might appear to call more frequently and imperiously for narcotics than wakefulness or the irritability of disease. But it is otherwise; though it is for the relief of pain that narcotics are most abused, and where they do their greatest injury. Whether they will be now beneficial will depend upon the cause of the pain, its seat, and other circumstances. If owing to active inflammation, they will be likely to aggravate the disease in most parts, but not in all. And here we learn the vast importance of a critical knowledge of the special vital endowments of the different tissues, and of a studious reference

to the seat of disease, as well as a critical examination of the attend ant symptoms, since the pain of mucous and serous inflammation of the intestine may be exactly the same, and opiates curative in the former, but certainly fatal in the latter (§ 133, &c., 150, 685, 686). Here, too, in the mucous tissue, they accomplish the double purpose of reducing irritability as well as sensibility (§ 150, 188, 194). In the other case, or that of serous inflammation of all parts, if they render sensibility obtuse, they do not often fail to injuriously modify the irritability of the part, and thus aggravate the disease. In the same general sense, also, opiates are more or less suited to inflammatory states of the whole mucous system.

891, *l*. But, the great agent for the relief of pain attendant on active inflammation of any tissue is bloodletting; and this, particularly, when the disease affects any great vital organ. In a general sense, also, the less important the part the safer will narcotics be in inflammatory affections, whether acute or chronic; though, in these cases, care should be taken that they are not contra-indicated by obscure conditions of disease in the complex and great organs of life (§ 150, 689 *l*, 863 *d*). And here it is well to remark, that the organs most important to life are far from being most liable to pain. This is true of the lungs in pneumonia; and the liver, also, is but little subject to pain in any of its diseases, while the pleura, or peritoneum, or thecal membranes, the ligaments, &c., are never much inflamed without great attendant suffering. The urinary and generative organs are liable to very painful affections; and here, most happily, narcotics are very often admissible in their acute inflammatory diseases. So, also, they afford immense temporary relief in pain of the stone. They operate like a charm in cramp of the stomach, and in the suffering attendant on the passage of a gall-stone along the ductus choledocus. In these last cases the narcotic is directly curative by relieving spasm.

When pain attends chronic affections narcotics may be administered with less hesitation; but still with a careful reference to the seat and nature of the disease. They are of the greatest value, as palliatives, in the pain of cancerous affections, and generally for the suffering attendant on the chronic maladies of most parts that have not strong sympathetic relations to important organs (§ 725, 859 *b*).

891, *m*. It may be said, in connection with the foregoing subject, that pain is very rarely a cause of disease, but may increase the force of such as may be present. But, even in these cases the aggravation of disease is owing more to the general disturbance inflicted, and to privation of sleep, than to any direct influences upon the part affected. Great suffering may exist without disturbing even the action of the heart, if the subject be firm of endurance. If the general circulation be disturbed as the apparent consequence of pain, it is mental emotion, not the pain, which produces the phenomenon (§ 167 *f*, *note*). Indeed, the true philosophy of life conducts us to the above conclusion, since the property upon which pain depends is not interested in the organic functions (§ 194, &c.). In the foregoing manner, or through the medium of the various mental emotions it produces, pain may aggravate or develop an attack of disease; and it is through the medium of the cerebro-spinal axis that it increases disease without the intervention of the passions, that is, by alterative reflex nervous action.

The power of endurance, and, therefore, the degrees of injury which

pain may inflict, depend greatly upon temperament, and the general condition of the constitution as arising from disease, habits, culture of mind, &c., and these contingencies affect, also, the susceptibility of the vital states. Much, too, will depend upon the *kind* of pain; and the kind, also, has its important influence in directing the treatment.

891, *n*. Owing to the prevalence of sympathies, the patient is often liable to be deceived as to the true seat of pain; and an inattentive or ignorant physician may be thus led into the greatest mistakes (§ 526 *d*, 891½ *b*). Diseases of the liver, for example, give rise to pain in the right shoulder, which opium may relieve, while it would aggravate the hepatic affection. Or, if he apply a blister, or other agents, to the shoulder, they will be useless. But, if placed over the seat of the liver, they will be more or less likely to relieve the remote sympathetic affection. This, also, enlightens us as to the importance of addressing our remedies, in all cases, mainly to the organs upon which sympathetic developments depend, and where they may remain under the influence of the primary affection (§ 689 *l*, 905).

891, *o*. We see, therefore, that blisters are among the great means of assuaging pain; but, like bloodletting, they operate in a very different manner from narcotics, though by reflex nervous actions.

There are, also, other agents not of the class of narcotics, which are remarkable for their control over the pain of particular modifications of inflammation, such as colchicum, guaiacum, &c. (§ 892 *b*, *c*,).

Hence we see, more and more, the uncertainty of pain as a guide to treatment, and that our remedies should be mainly determined by other considerations. Nor will I neglect the opportunity of saying how deeply all this subject relative to pain, wakefulness, &c., and the counteracting influences of the narcotics, should impress us with the futility of the chemical and physical philosophy of natural and morbid processes. From what we have seen, too, of the great variety of means by which pain may be assuaged, we come to an unhesitating conclusion as to the modus operandi of narcotics.

891, *p*. There is one agent not yet mentioned, which is often very remarkable for the relief which it affords in tranquilizing restlessness, allaying pain, and in procuring sleep; while it has also the great advantage of being generally free from objection. This is the warm bath; or analogous means in the form of warm fomentations and poultices. By these means intestinal pains, strangury, the intense suffering from sprains, painful menstruation, &c., are frequently dissipated at once. Again, refreshing sleep may be often induced by the warm bath when narcotics fail, or would be injurious (§ 150, 863 *d*). These agents are also curative in a direct manner; but variously so, according to the nature of the affection and the degree of heat employed. The bath at 105° or 110° F. frequently, perhaps daily applied, establishes such impressions upon the skin that highly salutary influences are often reflected upon some chronic forms of hepatic and intestinal disease, through the communicating sensitive and motor nerves.

As farther illustrative of the remedial nature of narcotics in relieving pain, and as contributing to many general objects in the philosophy of life, I may advert to the manner in which certain affections of the mind arrest intense suffering, remove wakefulness, &c. This is strikingly shown in the sudden subsidence of toothache when the dentist is expected, and in the relief which follows the exercise of

charms, &c. Certain sounds, also, by awakening agreeable emotions, produce similar results; as variously observed in the effects of music, the monotonous bubbling of the brook, &c.; and here the *direct* nervous influence illustrates the *reflex* of narcotics (§ 844).

891, *q*. Narcotics are generally directly sedative, though there is sometimes a temporary excitement of the general circulation. But, their great effect, and which is positively conclusive of their sedative action, consists in lessening irritability and sensibility in a direct manner. Nevertheless, opium is considered by many as the most powerful stimulant; which shows the importance of correct views in the philosophy of life (§ 1057).

891, *r*. Narcotics generally produce their effects with rapidity, so that when their repetition is indicated for immediate purposes, the intervening time need not be long. And this leads me to advert to the remarkable manner in which pain often counteracts the sedative effect of narcotics, and enables the patient to bear a quantity that would be fatal in health. The solution of this problem is even beyond the compass of the physiologist; nearly as much so as that of sleep (§ 137 *e*, 150, 151, 175 *c*, 500 *n*).

Certain special affections of the nervous system also counteract the usual effects of narcotics in an astonishing manner; as seen in delirium of drunkenness, which excites an irritating nervous action.

891, *s*. Finally, habit, in respect to the use of narcotics, is very remarkable. Instances are authenticated in which the habitual use of opium has enabled individuals to carry it to the extent, daily, of more than three hundred grains. Solidism and vitalism point to correspondence between the general results and the amount of impression upon the stomach for an interpretation of the philosophy (§ 841).*

ANTISPASMODICS.

891½, *a*. Two principal objects are contemplated in rendering the antispasmodics a subject of consideration. First, to aid in illustrating the philosophy which concerns the nervous power; and, secondly, to indicate their misapplication in many conditions of disease.

891½, *b*. The group of antispasmodics embraces all the narcotics, and regards them in the special acceptation which it is my present purpose to consider. As the term implies, they are employed for the relief of spasm, and, mostly, of the voluntary muscles. Now these agents are very commonly applied for the relief of the symptom, and with too little reference to the fundamental cause. Thus, Dr. Paris says that "*Spasm may arise from excessive irritability, as from teething, wounds, worms, &c., in which case a narcotic would prove beneficial*" (§ 526 *d*, 676 *b*, 891 *n*). I have taken this illustration because it is quoted by others as a good example of spasm where the narcotic antispasmodics may be properly employed. But, to my mind, all the conditions which are here stated very rarely admit of relief from narcotics, and are often aggravated by them. The spasm imputed to teething may depend upon a variety of pathological causes, however the irritation of the gums be a concurring cause. If it be due alone to dentition, lancing the gums is the remedy. If to intestinal disease which is maintained by teething, the remedies are then the foregoing and others of greater importance relative to the abdominal affection, such as calomel, castor oil, warm fomentations to the abdomen, &c.

* See NOTE H p. 1117.

If narcotics be now employed, it is for the purpose of allaying intestinal irritability, and not at all with a view to their direct action on the cerebro-spinal system. As to spasm from wounds, the narcotics have been most extensively tried and abandoned as useless, excepting where they are slight; and then, more relief may be procured by a warm poultice applied to the wound. If worms be the cause, we ought surely to look for the remedies among the anthelmintics (§ 150, 526 *d*, 891 *n*, 859 *b*, 863 *d*).

891½, *c*. Antispasmodics have been largely employed in *hysteria*. But here they have been almost as fruitless as in the spasms of children; though, perhaps, not so detrimental. Hysteria, in numerous instances, is so dependent on some uterine derangement, and this condition so often consequent on visceral disease of the abdomen, that the treatment should be, in such cases, of quite a compound nature, but in which antispasmodics can take no useful part. An emetic, however, in a general sense, will afford temporary relief, which it accomplishes in part by modifying the several conditions of disease, and in part through influences which are called into operation in suspending a paroxysm of spasmodic asthma, and hiccough, as explained in section 514, *c*, where the philosophy rests upon reflex nervous action.*

891½, *d*. *Chorea* is another complaint in which antispasmodics have been extensively employed, and with as little reference to the cause of the symptom. They have, therefore, failed, or have left the patient for the worse. Abdominal disease being at the foundation, the remedies should consist of cathartics, a well-regulated diet, exercise, and change of air (§ 150, 863 *d*).

891½, *e*. But, worse than all, antispasmodics have been in high repute for epilepsy; notwithstanding their universal failure to afford any relief. The disease, however, is attended by spasm, and the symptom, as in the other affections, has been taken for the disease, and no small amount of suffering and death have been accordingly inflicted by antispasmodics. In many cases this affection depends, immediately, upon cerebral congestion; and then bloodletting, mostly, is the proper remedy. At other times it is owing to a transient sympathy of the brain with an overloaded stomach; when a mild emetic is the sure antispasmodic. In other cases the sympathetic disturbance of the brain depends upon profound disease of the liver and other abdominal organs; and here, cathartics of calomel, &c., and doubtless bloodletting also, are the appropriate means. Again, it depends upon organic disease of the brain, or on a spicula of bone projecting from the dura mater, or on depression of some part of the cranium.

The foregoing are almost all the causes of epilepsy; from which it results that antispasmodics should have no place among the remedies for this affection (§ 150, 847 *g* 848, 859, 863 *d*, 870 *aa*, 1058 *v*).

891½, *f*. Congestive asthma, the usual form of the disease, has had its full share of the antispasmodics, and, of course, with as little benefit as they have yielded to the preceding affections. They are more or less appropriate, however, to the rare form of spasmodic asthma; but here an emetic is often better, or a pipe of stramonium leaves may answer (§ 514, *c*). But congestive asthma depends upon something more than simple irritation of the nervous centres. There is a highly-injected state of the venous system of the lungs, consequent on disease of the abdominal viscera, involves many important organs, and

* See NOTE Cc p. 1132.

calls imperatively for blood-letting, and cathartics (§ 150, 786, &c., 847 *g*, 848, 859 *b*, 863 *d*, 870 *aa*).

891½, *g*. We have thus seen various examples in which *reflex* actions originate either in sensitive fibres of cerebro-spinal nerves and terminate in motor sympathetic fibres or *vice versa*, and *direct* nervous action originating in the brain or spinal cord and terminating in motor fibres of the sympathetic system (§ 111–113, and *references* there, 488½, 893 *a*).

891½, *h*. It appears, also, that the true narcotics must be commonly injurious in most of the affections which give rise to spasms.

891½, *i*. But there are some agents which are mostly antispasmodic, in their relation to the nervous system, such as asafœtida, musk, valerian, &c. These agents are known as the true antispasmodics, although opium greatly transcends the whole in its virtue of arresting spasm. But those of simpler virtues are very circumscribed in their morbific relations to the brain and to other organs, and exert but little effect as therapeutical agents (§ 150). This leads me to consider the remaining object of the present inquiry (§ 891½, *a*).

891½, *k*. No one can mistake the immediate bearing of the whole of this subject upon the general philosophy which concerns the modus operandi of remedial and morbific agents, while the function of respiration, and other natural processes, display the physiological laws under which the former are directed (§ 462–475, 495–534, 639 *a*). Although, therefore, the phenomena of spasm form so luminous a guide through the whole labyrinth of sympathy, and impart a peculiar interest to the discovery of Sir C. Bell in relation to the different orders of nerves (§ 462–470, 476 *b*), we need not be long detained in making the contemplated exposition.

In the first place, then, we observe that the irritation of the nervous centres may be either direct, as in severe forms of epilepsy (§ 891½, *e*), or indirect, as in the more compound and ordinary reflex nervous influences (§ 227, 230, 500). In the former case the nervous power is developed in a direct manner, either in virtue of some disease affecting the nervous centres, or by some direct mechanical irritation, as in depressions of the skull-bone, projecting spiculæ of bone, and extravasated blood (§ 476–494). In the latter case the primary irritation is in a remote part, as in the gums, or intestinal canal, &c (§ 891½, *a*). In this instance the impression is transmitted through sensitive nerves to the nervous centres, where it operates as an exciting cause of the nervous power, and is exactly equivalent to the direct irritation of those centres; as observed in the former case. The residue of the process then becomes alike in both the cases. That is to say, the nervous power is reflected through motor nerves, or motor fibres of compound nerves, upon the affected muscles, and thus are they thrown into spasmodic action (§ 230, 233, 500, 893½.)

Such, again, are all the elements; and since they are now in operation in their morbid aspect, we have the plainest demonstration that the whole process depends upon natural physiological laws.

And now, briefly, for the opposing or curative influences. We have seen that when the simple antispasmodics arrest the movements, they institute only mild impressions upon the nervous centres; but they must necessarily modify the nervous power in its very nature, or they could not arrest the movements of the muscles; since it is the nervous power which now operates, and upon exactly the same mus-

cles in which it had developed the spasmodic action.* In one case, therefore, it acts as a stimulant, in the other as a sedative. More or less, however, is due to a mere suppression of the exciting nervous influence. The same results obtain, also, when the narcotics operate in simply removing spasm. But these are agents which embrace other virtues that are very apt to prove morbific (§ 891, *d*), and their morbific impression may be transmitted from the stomach to the nervous centres, especially on account of their specific relation to the nervous system (§ 137, *c*), without first engendering or increasing disease in the stomach or other parts (§ 502, *c*), or, there may happen along with this a direct morbid change in the condition of the stomach (§ 502, *c*), or indirectly, through the increased morbid change in the nervous power, in other parts. These new conditions of disease may aggravate the spasmodic affection; since the nervous power is not rendered sedative to the affected muscles (§ 150, 228 *b*–232, 233¾); or, on the other hand, the morbid change may be of such a nature as to break up the special condition of the nervous power which gives rise to the spasm, and thus put an end to that part of the malady, although there ensue a very aggravated state of disease (§ 890, 900, 901, &c.). Thus we see presented the compound aspect of a remedial agent bringing about relief to one part of disease, or removing one symptom, and simultaneously aggravating or inducing disease in other parts, and increasing all other symptoms. The principle is distinctly the same, throughout, as when the narcotics, or simple antispasmodics, establish that change which results only in the removal of spasm. There is, therefore, presented in the examples before us, as a general ground for the interpretation of morbific and remedial agents, the union of the physiological, morbific, and remedial processes (§ 903, 984 *b*).

From the foregoing facts and philosophy we might reason safely to the modus operandi of all other remedial and morbific agents, especially in connection with the natural processes of sympathy (§ 500), had we not about the same amount of concurring proof in the manifestations of every other cause.

CINCHONA, AND ITS ALKALOIDS.

Tuto, cito, et jucunde.

892, *a*. As an interesting incident in the history of this extraordinary agent, it may be said that the Peruvian bark was not introduced into Europe till the year 1640, or more than one hundred years after the full conquest of Peru; which is abundantly conclusive that all the alleged connections of the savages, lions, and vultures, which continue to appear in works on the Materia Medica, are wholly fabulous. It was not, however, till a century afterward, or in 1738, that the plant became known to naturalists, through Condamine, the French savant. His account of the tree appeared in the Memoirs of the French Academy, along with the story about the lions. Condamine says that the Countess *del Cinchon*, wife of the Viceroy of Peru, carried the bark to Europe in 1640; from which circumstance, and from her previous connection with the introduction of the bark into use, as stated by Condamine, Linnæus immortalized her name. The countess brought the bark into use in Peru by a first experiment upon herself, at the suggestion of the Corregidor of Loxa. She then transferred its patronage to the Jesuits; when the bark dropped the name of the "Count-

* Shown also by certain external applications, as when camphor or ice applied to the skin relieves instantly the spasms in malignant cholera (p. 838, § 1057½).

ess' powder," and became known as the "Jesuits' bark." It would be an entertaining inquiry to follow the history of cinchona after its introduction into Europe. No article of the Materia Medica has employed so extensively the pens of medical philosophers, and under every aspect of praise and condemnation, and of angry controversy; and next to this, that now universal luxury of man, the nicotiana tabacum. Before the time of the alkaloids, Von Bergen published the names of more than six hundred authors whose writings he had consulted on the subject of the Peruvian bark, and refers to eight hundred distinct treatises upon this remedy. Subsequently to that period, the discovery of the cinchona alkaloids, and their application as therapeutical agents, have given rise to so vast an accumulation of books, pamphlets, and memoirs, that the writings upon this single article of the Materia Medica would, alone, form a library of very imposing dimensions. And yet do I find myself at the threshold of another paragraph upon what should seem so completely exhausted. I shall therefore endeavor to turn myself upon that track which has been least pursued, and which, as in many other cases, is too often abandoned,—the path of Nature.

The bark, having been early carried from Spain into Italy, it may be well supposed that a country so liable to intermittents, and those, too, of the most formidable character, would soon illustrate the virtues of this extraordinary febrifuge, and enlist in its favor the most powerful patronage. About this time, however, it was called to encounter one of those checks which it repeatedly afterward underwent with less disaster, and which will remind us of what has befallen the philosophy of medicine in the laboratory of a German chemist. I shall therefore state it, in the hope, at least, that it may go with the rest in promoting independent habits of observation (§ 349 *d*, 350, 350½).

The commendations which the bark received from the priesthood, and the popular appellation of the "Jesuits' bark," were not sufficient to establish its success in countries less scourged by malaria than the Peninsula; for even in Spain the physicians were either disposed to reject the remedy, or to meet it with opposition. But, its demonstrations were such in the Italian climate, that Pope Innocent the Tenth made it the subject of a papal communication to the Church, and co-operated with the Italian physicians by directing the publication of their report; in which the curative virtues of the bark were set forth with all the confidence that has been warranted by subsequent experience.

The medical document which was thus promulgated was called the "Schedula Romana," and contained directions for administering the bark as to time, quantity, &c.; the established dose being two drachms of the powder.

This Schedula soon became a target for those who had been hostile to the bark; and the warfare was begun by one who had professed to have entertained prepossessions in its favor. This individual, whose name was Chifletus, was prompted in his opposition to the bark by its partial failure in a case where it was important for the physician to have obtained more complete success. A relapse, however, ensuing at the end of a month, the chagrin of the physician led him to denounce the remedy in such violent terms, that it lost, at once, many of its firm friends, and rekindled the animosity of its opponents

Chifletus boldly assumed that all the Roman and other encomiums were mere pretense, and that the bark was not only useless as a remedy for fever, but absolutely pernicious, and should be utterly proscribed by the profession. He challenged any well-authenticated cases of cure; and by this arrogant style he attracted the attention of no small part of Europe. The credulous came to believe his assertions, and the evil-disposed united in a crusade against the tenant of the Andes. Chifletus was hailed as a great public benefactor, as "the Reformer" of the day, in having relieved the world of a scourge. His publication was reprinted in the languages of different European countries; and, for awhile, the whole profession appeared to acquiesce in the justice of the decision.

Nor was this condemned article ultimately rescued from the trammels of ignorance and prejudice by its proper guardians; but by a learned Jesuit, who once more bore it aloft by unequivocal proof of its extraordinary control over the great bane of Italy. From that time, opposition became more and more feeble, and the merits of the remedy gradually established.

But, this is only a passage in the early history of the Peruvian bark. It was not, like the tobacco, required to encounter the edicts of despots, though it equally underwent the ordeal of a fierce disputation; and it is scarcely possible for us, who now contemplate these two remarkable members of the vegetable kingdom with the calm indifference of long and universal experience, to appreciate the uncertainty in which their virtues were held, or the angry and vindictive reproach to which that uncertainty gave rise.

We see, also, in the nature of the hostility which was for awhile waged by a great part of the profession against this invaluable remedial agent, and in the very face of its triumphant success, a disposition to trample upon the best interests of society, where it may seem expedient to bow to the dictates of a despotic writer, or where professional pride, or cunning jealousy, or malevolent envy, may hope for gain. Nor can we fail to observe in this extraordinary and almost universal denunciation of the Peruvian bark, as a curse which was scarcely exceeded by pestilence, a striking parallel with the furious opposition which bloodletting has been required to encounter.

It is also an interesting, as well as instructive, coincidence, that while Sydenham was storming the prejudices against the *remedium principale* in the treatment of inflammations and fevers, he was also employed in combating the opposition to the bark, which had become very general in England. He triumphantly set forth the advantages of the former, and compelled his obstinate cotemporaries to acknowledge the healing virtues of the Peruvian febrifuge. But, to the Pontine marshes of Italy we may refer the stability which was first bestowed upon the bark. Here were perpetually emitted the seeds of intermittents, which were now, for the first time, controlled extensively by the all-potent drug.—Notes F H K pp. 1114, 1117, 1119.

892, *aa.* In my Arrangement of the Materia Medica, I have grouped together, in the order of their therapeutical value, many agents which are peculiarly appropriate to intermitting forms of disease, and, into this group no other remedies are admitted. They possess, therefore, what are commonly denominated specific virtues in relation to the diseases to which the group refers. This, indeed, may be more

or less affirmed of all the other groups, excepting those of a common antiphlogistic nature. It is not, therefore, to be inferred, when the remedies for any given character of disease are specifically indicated, that there may not be others that are more or less appropriate, but which are not included in the group before us (§ 137 *d*, 150). Cathartics, even, are liable to this qualification; since, without previous blood-letting they will often aggravate disease. But, after applying the former remedy the cathartic may cease to be necessary. The loss of blood has accomplished all that was contemplated from the internal agent; but blood-letting cannot be arranged among the cathartics. In certain conditions of amenorrhœa it may be evident that guaiacum will establish menstruation after blood-letting or a purgative, but would be injurious without, or either of the last may be sufficient. Now, the same remarks are precisely applicable to the group of anti-periodics, unless it be that the virtues of these remedies have a remarkable bearing upon the remote causes of intermittents (§ 650, 652 *c*, 653, 662, 675).

892, *b*. It is the prevailing doctrine that cinchona, arsenic, and other anti-periodics operate by either neutralizing some imaginary poison, or by forming chemical combinations with the tissues of the body, and thus transmuting them into their normal conditions; while there are a remaining few who ascribe the results to molecular changes induced by a tonic or astringent principle, as in tanning (§ 350, nos. 41, 42, 487 *h*, 569, 851 *a*, 890 *a*, 892¼ *i*). On the contrary, I endeavor to show that these remedies in subduing special forms of inflammation and fever operate upon the same principle as loss of blood, cathartics, and antimonials, in the common forms, and therefore as antiphlogistics (§ 756 *a*, *b*). Excepting loss of blood and the antimonials, the remedies which are appropriate in a general sense to inflammations and fevers will often prove morbific in some of the pathological phases of the common forms of those diseases. Cathartics are comparatively of little use, and often injurious, in pneumonia, pleuritis, enteritis, phrenitis, &c., without antecedent loss of blood; and this is still truer of vesicants, which may ultimately render important service in those diseases. But there is a large class of inflammations which deviate from the common form, known as *specific* (§ 648, 653, 721–722). Here, however, the same principle obtains, and is corroborated by a greater variety in the means that may be suitable to the special pathological conditions. Intermitting inflammation and intermitting fever are specific forms of inflammation and fever, and are so far bent from the common forms as to be benefited, in connection with the general antiphlogistics, by many heterogeneous remedies of special virtues, but which will aggravate the common forms of those diseases. And just so of chronic rheumatism, for which colchicum, and guaiacum, and veratria, and other acrid and miscellaneous substances are special remedies, but which will aggravate not only the common form of inflammation but even acute rheumatism. Blood-letting, however, and tartarized antimony, are the main remedies for intermitting inflammation and acute rheumatism, and generally the best for the chronic forms. It would be, therefore, equally necessary to deny that loss of blood and antimonials act as antiphlogistics, in the vital acceptation, as the foregoing specific remedies, and to assume that the entire medley, indiscriminately employed, lead to a common result in the cases supposed by some common neutralizing or chemical process (§ 350, nos. 41, 42)! As well might it be assumed that any of the

remedies for intermittents will unite and form an identical compound. The mercurials will oftener overcome syphilitic inflammation than any other form, and oftener than any thing else. But iodine, and sarsaparilla, and a non-stimulating diet, and frequently loss of blood, are very good remedies. And so of scrofula, in which the general antiphlogistics are often necessary, but mainly sudsidiary to iodine and bromine, while the latter never fail to aggravate the common form of inflammation (§ 851 *a*, 863 *d*, 892½ *v*, 892⅘ *g*, 896–900, 904 *c*, 905¾, 951 *c*, 1065).

Having thus divested this plain affair of the mystery which has been thrown around it, and seeing clearly the simple principles through which all remedial effects are produced, we may bring the philosophy with no little aid to our experience in the treatment not only of intermittents, but of all other diseases.—Notes K L pp. 1119, 1120.*

892, *c*. The considerations to which I have now referred, along with what is known of the peculiarities that appertain to the virtues of every remedy, and how those virtues may prove morbific as well as salutary, enable us to understand the favorable and unfavorable relations which cinchona, or arsenic, may bear to the different stages of a paroxysm of intermittent fever, when to apply the remedies and when to withhold them, how they may aggravate any coexisting local congestion or inflammation, or how, from our knowledge also of the modifying effects of the remote causes, these agents may, at other times, arrest the local as well as the general disease, or how other agents, like bloodletting, will place the unfavorable states in a favorable way for the action of the tonic febrifuge (§ 150, 675, 847 *g*, 848, 857, 859, 863 *d*, 870 *aa*). We learn, also, from the same considerations, and from what is set forth in section 904, *d*, that no remedies can be properly regarded as specifics, neither cinchona, arsenic, &c.; since, from the vast variety and contradictory nature of the means by which intermittents may be arrested, we may clearly perceive that no one of these causes exerts what is understood by specific effect. The several means, however, arrest the disease; and they do it by instituting such changes in the diseased conditions as place them in the way of restorative changes (§ 672). Each one, however, determines changes according to its own special virtues, and in no other sense are they specifics. So far, then, they are exactly on a par with any other remedy, and with every cause of disease (§ 52, 150, 151, 650, 892⅗ *d*). But, this peculiarity of virtues is more strongly pronounced in some things than in others, and is seen remarkably in cinchona; as in its profoundly morbific effect during the hot stage of the febrile paroxysm, and its equally curative demonstration during the period of intermission. Here, too, I may again say that its mode of operating at these successive stages of one and the same disease is distinctly seen to be of a common nature (§ 675, 891½ *k*). Here we have not only a consistent philosophy throughout, but, also, in that philosophy and the attendant facts a fountain for many practical conclusions; such, for instance, as the importance of bringing about, in a general sense, distinct intermissions before resorting to what are emphatically denominated remedies for intermittents; and that it would be improper, in a general sense, to employ the agents now under consideration, in remittent fever, or, at most, not till the febrile action has been modified by direct antiphlogistic means (§ 150, 847 *g*, 848, 857, 859 *b*. 870 *aa*, 1059.—See *Modus operandi* of Cinchona, p. 677, § 904 *d*)

* Also, Note Ee p. 1133

Nor may we begin, precipitately, the treatment of intermittents by cinchona, nor by any agents of the present group, simply because it is an intermittent, and there happens to exist that suspension of febrile action which is known as the period of intermission (§ 675, 890, *d*, 891 *k*, *l*). There may be present some local congestion or inflammation that may demand the abstraction of blood; and the general condition of things will rarely fail of requiring a cathartic, at least. But, it often happens before any preliminary treatment may have been adopted, that an intermission is pretty strongly pronounced, and yet that the intensity of the febrile condition is such as to raise apprehensions that the patient may be destroyed by the violence of the next paroxysm. These are frequently cases for grave deliberation, whether we shall abstract blood, or administer a purgative, or an emetic, or proceed at once to the employment of bark. If no important local disease be present, some eight to fifteen grains of calomel should be given, followed soon by an appropriate dose of castor oil, and, in the mean time, the sulphate of quinia should be exhibited till the next paroxysm takes place. It will not do to prostrate the system in these cases by an emetic. In the way now suggested, however, we may stay the violence of the approaching shock. Will chemistry explain?

On the other hand, if there be any serious amount of congestion in the liver, or inflammation of the intestinal mucous tissue, as commonly happens with the liver especially, we shall accomplish nothing by this early use of the bark, in these concentrated forms of fever. Either trust alone to the cathartic till after the next paroxysm, or bleed the patient also. There is no "debility" in the case. Keep the eye on the pathology. Nature may rise up at once under the lancet, when she would sink under an emetic, or the tonic virtue of the febrifuge (§ 150, 569 *e*, 576 *e*, 847 *g*, 848, 857, 859 *b*, 863 *d*, 870 *aa*, 961, 962).

892, *d*. Having brought the system into a condition for the administration of cinchona, or some of its preparations, we are next to ascertain which of the two methods should be adopted; for there are two modes of treatment having essential differences.

One of these methods consists in making a very strong impression, at once, by a single blow, as it were, upon the diseased conditions, during the intermission, by the administration of a large dose of bark, or of quinia (as five or ten grains of the latter), and thus endeavoring to arrest the fever at once.

The other method is one of greater moderation; the remedy being exhibited in small quantities (as that of a grain of quinia), at intervals of two to four hours throughout the intermission.

By the latter process the alterative action is more gradually exerted; so that the paroxysms may continue to recur an uncertain number of times, but with diminished intensity, till, at last, they disappear.

And now as to the relative advantages of the two methods. In the first place, we can readily understand, theoretically, that the precipitate course, by large doses, may exasperate any coexisting inflammation or venous congestion; and yet, from the difference in the pathology of fever and inflammation, the former condition may be overthrown.

We know, also, that it will not answer to arrest the fever suddenly by arsenious acid; because a large dose of that remedy may inflict a far greater evil than is constituted by the fever. Such, in fact, is the

negative reason; for an excessive dose of arsenic may arrest the complaint at once. It is only, therefore, its liability in large doses to inflict other mischief that prompts its administration in small doses. And just so it may be with cinchona, or its alkaloids, and their salts. In the former case the morbific effects are strongly pronounced, and the agent is not prescribed at random. But, it is quite otherwise with the large doses of quinia. The attending venous congestions, which are very apt to be present (and far less frequently other forms of inflammation), may be increased and established without manifesting any striking phenomena to admonish a hasty practitioner of the mistakes he may have made (§ 790, 795 *b*, 798, 801, 806, 807, 811, 815, 816, 961–964, 967).

Now, experience shows exactly what theory, suggested by the true operation of remedies, rendered more or less probable. Experience, I say, shows that, though bark, and its alkaloids, in large doses, will often arrest intermittent fever suddenly, such doses are liable either to induce some congestion, especially of the liver or of the mucous tissue of the stomach, or will aggravate and establish some coexisting congestion; and thus, while the patient is, for the present, relieved of the fever (§ 904, *d*), he is dismissed with an insidious local complaint that not only renders him a permanent invalid (resulting often in indurated enlargements, § 803), but which local malady may, and often does, become, in a process of time, the exciting cause of another attack of fever; thus showing, also, that the predisposition to the constitutional disease remains, although the paroxysms, and therefore its absolute condition, were interrupted (§ 150, 560, 665, 666, 779, 904 *d*).

In other words, while we thus inflict a useful and sudden blow upon the fever, or general malady, through one virtue of the bark, we lay the foundation of a local disease, through the tonic virtue, in itself perpetually harassing, undermining the constitution, and not unfrequently so establishing the predisposition to fever, that the patient will continue to suffer returns of it from time to time during the residue of the brief period of life which an indiscreet practice not unfrequently allots to him. He is but "imperfectly cured," as Celsus has it; and these imperfect cures become the slow cause of those chronic enlargements of the liver and spleen for which iodine is especially beneficial. In respect to relapses, it is not infrequent that, when intermittents are suddenly stopped by a large dose of quinine the paroxysms return as soon as the patient begins to exercise much, or to take his ordinary food,—certainly with far greater frequency than when the case has been treated upon the moderate system (§ 847 *g*, 848, 857, 859 *b*, 870 *aa*, 878).—Notes K p. 1119, L p. 1120.

It is now interesting to remark that the plan of large medication is apt to be adopted by those practitioners who are least inclined to recognize bloodletting as of much importance among remedial agents, or do not see in the philosophy of disease any other elements than debility and something in the blood to be expelled or neutralized (§ 569, 960), and suppose that medicines do the whole work of cure (§ 853, 856).

On the other hand, when the gradually alterative process is pursued, the patient is not only about as expeditiously relieved of the fever, but, also, of his local congestions; for, Nature has now a chance to throw off these more obstinate affections (§ 904, *d*), which she is greatly disposed to do while undergoing the gradual removal of the febrile

action; so only we do nothing to interfere with these local salutary efforts (§ 662). But, there is also the more important advantage resulting from the negative fact of not directly increasing, or actually producing, congestions by the milder system of treatment.

According to this plan, certain other objects of the highest importance are not as likely to be overlooked as when its antagonist is brought into action. It presupposes a tolerable regard for the existing state of the pathological conditions before the treatment is begun, that care is taken that all congestions or inflammations of important organs are so far mitigated by bloodletting or cathartics, or by antimonial alteratives, and the intensity of the fever so far subdued by some one or more of those direct antiphlogistics, as shall render the tonic febrifuge not only safe, but speedily curative (§ 150, 151, 847 *g*, 848, 857, 859 *b*, 863 *d*, 870 *aa*); for speedy it will almost always be when its administration is proper, and the case continues to be judiciously treated. If the intermissions be not well marked, there probably remains some special burden of disease upon the stomach, or liver or other important organ, which should be yet farther mitigated before the use of the tonic febrifuge is begun; although, as already seen, it may be sometimes employed in cautious doses where the local inflammations and venous congestions have refused to yield to bloodletting, cathartics, antimonials, &c., and even now and then at rather advanced stages of the disease where the paroxysms run into each other (§ 662). In all such cases, however, we should move on with great circumspection; never employing the agent of tonic virtues till it become apparent that this form of fever, and its local complications, are not likely to surrender to the direct antiphlogistic means (§ 870 *aa*).

Among what may be considered the subordinate remedies, but which are truly among the most important, are perfect rest in bed, and a total privation of stimulating and solid food during the existence of the fever, whatever may be its prolongation. It is astonishing, I say, what an important agency these two negative remedies exert. Animal food, although it be fluid, will stimulate injuriously, or, if the food be in a solid form, it will irritate the stomach mechanically; while the erect posture, if long continued at least, proves in other ways an exciting cause. And then, as to all those things which so falsely pass under the denomination of refrigerants, such as the acid of lemons, oranges, &c., they never fail of so irritating the intestinal mucous tissue as to aggravate the symptoms which they are intended to assuage. A cathartic, or bloodletting, are the only things that deserve such a name, unless it be ice; and even in regard to ice itself, either of the first means may prove far more refrigerant to the organic being (§ 150, 151, 440 *e*, no. 14, 441 *c*, 442 *b–e*, 443 *c*, 447 *c*, *d*, 447 *h*, 447½ *f*, 863 *d*).

A proper want of attention to food, and fatigue from exercise, during convalescence, are the great causes of the relapses which take place after well-treated cases of intermittent fever. Almost any thing will arrest the paroxysms when applied under favorable circumstances. And just so it is on the other hand; almost any thing unduly applied will reproduce them while the predisposition is strong, as it commonly is for some time after their subsidence. Will chemistry explain?

892, *e*. In the quotidian form I commonly exhibit one grain, in solution, of the sulphate of quinia every two or three hours during the

intermission. In many of the cases the patient does not suffer another paroxysm after the preliminary treatment and beginning the use of quinia; but, in a majority of instances he has another paroxysm, but of great comparative mildness. This, however, is almost invariably the last of the fever.

In the treatment of tertians, the intermission being longer, more time is allowed for producing the requisite impression by the quinia, and I therefore take no unnecessary risk of aggravating, or of produ cing any local forms of disease, but administer the sulphate of quinia in doses of one grain once in three or four hours; and I continue this regular exhibition of the remedy throughout the night. In a vast majority of these cases there has been no return of the paroxysm after beginning the use of the quinia—so only the fever have been a regular tertian, and the intermission well marked. But absolute rest, and a fluid, farinaceous diet, till there is a failure of the periodical return, are a sine qua non.

892, *f*. The various means which I have now stated as to the treatment of regular intermittents, with the exception of cinchona, are still more important in remittent and continued fevers; and their importance increases in the ratio of the intensity of any local inflammations and congestions of important organs. The former affection is here far more apt to spring up than in intermittent fever, especially in the continued form; while venous congestion is the predominating condition in intermittents and remittents.

892, *g*. When the hot stage of an intermittent is unusually prolonged I have found it most useful to employ not more than half a grain of quinine at a dose; and, in remittents, of the most formidable nature, after repeated abstractions of blood, and the exhibition of cathartics, especially of calomel, and alterative doses of tartarized antimony, I have in the end resorted to the sulphate of quinia in the minute doses set forth in section 870 *aa*, and patients have been thus rescued from otherwise inevitable death.

Here, too, as in numerous other gradations of febrile action, especially where the constitutional affection is not subdued into a distinctly intermitting form, or where it remains complicated with declining inflammations, quinine may be brought to bear advantageously in small doses, by associating with it the minimum doses of tartarized antimony, when the former agent would be otherwise morbific. The antimony lessens irritability, subdues arterial action, and thus counteracts the stimulant virtue of the tonic febrifuge, while it also reaches more profoundly by its alterative virtue. For an opposite rectifying influence tonics may be sometimes brought usefully to the aid of antimony; especially where unsubdued chronic inflammations are kept up by prolonged indigestion. So, again, cathartics, especially the neutral salts, may be added to tonics with the same double intention; or, on the other hand, tonics may be combined with cathartics to counteract the prostrating influence of the latter.

892, *h*. On the Continent of Europe, and in many parts of the United States, ten grains of the sulphate of quinia at a dose is common; and this explains the reason why an impression has obtained that this compound is apt to irritate the stomach, or to produce purging. If its full effects in such quantities were farther analyzed and better appreciated we should also hear of them much more unfavorable reports.

892, *i*. The celebrated French writer, and admirable practitioner Tissot, more than a century and a half ago, complained that the bark had suffered much in reputation from being employed in too small a quantity. The subject, in consequence, was submitted to the test of critical observation. The dose employed by himself, and which was about the same as sanctioned by the distinguished men of that age, was one drachm of the powdered bark. If the fever were of the tertian type he administered eight of these doses during the intermission, or a dose every three hours. For a quartan he prescribed the same dose, and at the same interval, so that, instead of an ounce, as in the tertian form, an ounce and a half would be taken during the period of intermission. "These doses," he says, "frequently prevent a repetition of the paroxysm." And this it would have done with greater success had it not been the usage of those days to enjoin exercise upon these patients, and even to allow them solid food during the intermission.

As to the quantity of bark, Tissot gave the maximum dose that was mostly employed. This was considered abundantly large. Tissot, indeed, observes that, "The frequent failures of the bark are owing to small doses. On such occasions the medicine is cried down and condemned as useless, when the disappointment is solely the fault of those who do not employ it properly."

If we allow, therefore, the large proportion of one grain and a half of the alkaloids to one drachm of good bark, and that the febrifuge virtue of cinchona depends mostly upon these principles, we shall not have more than one grain at a dose in actual operation, on account of the nature of the compound. But, in a great proportion of the barks in common use there is not the quantity of one grain of the alkaloids in a drachm of the bark. The crown bark of Loxa (C. Condaminea), an excellent species, and mostly in use in Tissot's day, has less than half a grain of the alkaloids to each drachm. These facts are of great practical moment as it respects the important question now before us; as they come from some of the very best observers, men who would venture upon bloodletting whenever necessary, and who had the same question under consideration.—Notes K L pp. 1119, 1120.

In Tissot's time, however, there were many who employed excessive doses of the bark, and thus injured or destroyed their patients. And this, of course, was another reason why the bark was often in disrepute. The alkaloids, it is true, are rather less morbific; but not at all so in the ratio of the moderate and immoderate practice. The consequences, therefore, are the same now as represented by Tissot, Morton, Torti, Sydenham, and others, in their times.

Be it also remembered, that they who are thus fearless of the cinchona alkaloids, and others who administer calomel by the table-spoonful in congestive fever, and tartar emetic in five to ten grain doses, repeated at short intervals, in the treatment of pneumonia, &c., are the very ones who most condemn the greatest, safest, and most speedy of all means for the cure of such affections. And just so, too, as in former times, the public, seeing the failure of their efforts with quinia, and other powerful internal agents, as is very natural with a class so entirely uninformed of the true merits of the case, run to an opposite extreme, and imbibe a belief that medicines are hazardous unless in such small doses as shall exert no effect whatever. The

confidence of the public being thus more or less impaired in the whole profession, there will not, of course, be wanting those who, as in Tissot's day, will take advantage of this false conclusion, and will, as in former times, employ cinchona, and other remedies, in such minute doses as will render no aid to Nature (§ 854 *bb*, 878, 894, *mottoes*).

892, *k*. The large medication by quinia may be traced up, in part, to the analogous use of tartarized antimony in Europe. But, while the treatment of intermittents by doses of five and ten grains of quinia has extended from Europe to America, we have not kept pace with its progress there. How far this practice has had its origin in physiological or pathological facts may appear from some of the results which have been affirmed by its advocates. Thus, the distinguished M. Piorry, having embraced the opinion of M. Louis that the enlarged and indurated spleen, a condition which often supervenes on neglected or badly-treated intermittents, is the cause of the fever, applied the treatment upon that hypothesis. Accordingly, we learn from M. Piorry the following results. In a patient, for example, affected with a quotidian, we are gravely told that,

"All the organs were HEALTHY, *except the spleen*, the length of which was seven inches and ten lines, breadth five inches and five lines."

To this patient thirty grains of quinia were given at a dose, and in twenty minutes afterward the hypertrophied spleen was reduced more than one inch in its length and breadth, as ascertained by percussion; but which we may regard as physiologically impossible. Four days afterward, as the paroxysms still continued, M. Piorry gave this patient forty grains of the sulphate of quinia at a dose; and measured the spleen by percussion in twenty minutes afterward, and found it more than four inches shorter than when the first dose was exhibited! Other cases of the same nature are related, in which he administered sixty grains of the sulphate at a dose; with the never-failing effect of reducing the spleen at least an inch in all its dimensions within the regular time (twenty minutes) after the exhibition of the remedy (§ 854 *bb*, 857, 878).

These reports of cases have been extensively circulated, and incorporated into the "experimental philosophy" of the day. Sigmond has a salutary remark upon this subject, which may not be without its advantages in this place. Thus:

"He who has in early youth sedulously watched the practice of hospital physicians, and has heard from them the mode of management which was formerly pursued; he who has compared what he himself saw at that period, with what he gathers from the most eminent writers, and has then enjoyed opportunities of drawing his conclusions from the bed-side of patients, both in public establishments and at their own houses, will be able to appreciate the difficulties which occur in the application to practice of the rules that are laid down by some individuals with such dogmatic precision; he can also judge of the inutility of those theories which appear based upon plausible foundations, and which are often promulgated by individuals who hastily draw conclusions from few facts, and who commence explanations of their own views, ignorant of what has been thought, said, and practiced by some of the able men who have preceded them; who are again reviving doctrines which time and experience

have already demonstrated to be erroneous. *The disregard of physiology and pathology has been one of the great fallacies of the age in which we live. The devotion to morbid anatomy*, however praiseworthy is its investigation, has absorbed too much of the consideration of some of our most eminent medical philosophers. They have rather reasoned from the ravages which disease has committed, than from the signs and symptoms, and from the gradual development of the morbid functions of organs. Hence fever has been imagined to be a local disease, and hence the various theories have led not only to unsound, but, in my opinion, to dangerous practice." "The enlargement and induration of the spleen, which attend upon mismanaged intermittent fever, are not uncommonly produced by the neglect of the proper means previous to the use of cinchona, and by its administration in the wrong stage."—SIGMOND'S *Lectures. London*, 1837.

892, *kk*. In what has now been said of the employment of cinchona with a special reference to chronic enlargements of the spleen (§ 892, *k*), it is not intended to be implied that the agent is not more or less adapted to such cases; as it is, also, to analogous affections of the liver, &c., which supervene upon intermittent and remittent fevers. But, in all such cases there are other means not less important; such as a well-regulated diet of mild vegetable food, leeching and vesicating the affected region, the local or internal use of iodine, &c. In all such cases, however, the doses of quinia should not exceed one grain; and the practitioner and his patient must yield to the necessities of the case, and be content with advances toward a state of cure that shall correspond, in some degree, with the gradual progress of the disease from its incipient to its aggravated form (§ 150, 548 *a*, 557 *a*, 855, 856, 926).

892, *l*. Pereira has presented a good summary of the effects of quinia in the exclusive practice, as inferred from general experience. Thus:

"In doses of *ten* grains, sulphate of quinia has produced on man three classes of effects:

"1. Gastro-enteritic irritation, marked by pain and heat of the gastric region, nausea, griping, and purging.

"2. Excitement of the vascular system, manifested by increased fullness of pulse and augmented respiration. Furred tongue, and other symptoms of a febrile state, are observed.

"3. Disorder of the cerebro-spinal functions, indicated by headache, giddiness, contracted, and in some cases dilated, pupils, disorder of the external senses, agitation, difficulty of performing various voluntary acts, somnolency, in some cases delirium, in others stupor." —PEREIRA'S *Materia Medica*.

Here, then, are a great variety of symptoms which denote the pernicious effects of quinia as having followed immediately its exhibition in doses of *ten* grains, and I have witnessed many of them from *five* grains only. But, it is these strong demonstrations only which are likely to engage the attention of a large class of practitioners, while the more obscure, but analogous effects of which I have spoken, pass unheeded, or are imputed to other causes.

892, *m*. Let us, then, look well to the preparatory treatment. Let us scrutinize the varied and exact pathology of the individual cases of intermittent fever; and clear up, at least, any local congestions

that are so apt to stand in the way of the tonic febrifuge. But, let us not neglect the important consideration that these local states are imbued with the special influences of the remote causes of the constitutional affection, and that they are more or less amenable to the Peruvian bark, and would, doubtless, be far more so but for the tonic virtue of the febrifuge (§ 650, 652 *c*, 662, 670, 814–816, 847 *g*, 848, 857). Where they are marked by periodical exacerbations they may refuse to yield in their specific nature to all things else than some agent of very peculiar virtues; and here it is that cinchona, or arsenic, manifest their effects as specifics. But it is far from being certain that such agents are indicated because the local conditions of disease do not give way to a direct antiphlogistic treatment. It may be that this treatment has been imperfectly applied, that too little blood, perhaps, may have been abstracted, that leeching or blistering have been improperly neglected, or out of their relative order to general bloodletting and cathartics, or, that some untoward exciting causes, such as errors in food, or fatigue, &c., have been in operation to defeat the right influence of the principal remedies for inflammation These are considerations of great moment, and should duly pass under review in all cases, before we summon to our aid the power in reserve; especially if the local symptoms do not fluctuate like the paroxysms of fever (§ 151, 675, 686, 847 *g*, 848, 870 *aa*).

Again, however, cases arise where the local affections put on a distinctly intermitting character. The symptoms of cerebral congestion rise and fall with the febrile paroxysms and the intermissions, or those of pleurisy undergo the same fluctuations. Here, therefore, there is little or no room for doubt, after a full impression has been made by bloodletting, cathartics, &c., upon the general pathological condition. This preparatory treatment adopted, the first moderate dose of quinine will often tell us that it has reached deeply the peculiar modification which had been impressed upon the congested or inflammatory states by the miasmatic cause; while, on the other hand, had the remedies for common inflammation been neglected, and no impression had been thus made upon the universal pathological condition, that grain, or less, of quinia would have exasperated the whole condition of disease (§ 137 *d*, 150, 151, 650, 672, 673, 801, 814, 857, 870 *aa*).

892, *n*. The foregoing peculiarly modified states of congestion and inflammation, in their supposed intensity (§ 892, *m*), are not, however, common in America; but, it is more common to find that remittent fevers, notwithstanding any remaining congestions with which they may have been complicated, will be ultimately benefited by very small and cautious doses of the cinchona alkaloids (§ 150, 870 *aa*).

892, *o*. It should be added that it has occasionally happened within the experience of the best observers, that acute and violent inflammations have occurred independently of intermittent fever, where the inflammation has refused to yield to bloodletting, &c., but has subsequently surrendered speedily to the bark. It can scarcely be doubted, however, that these rare conditions are under the modifying influence of the remote causes of intermittents (§ 150, 151, 813 *a*, 816).

892, *p*. Besides the affections which I have considered in the foregoing sections, there are others of an intermitting character to which the cinchonas, and their allies, are especially adapted. These are the well-known intermittent head-aches, intermittent neuralgia, intermit-

tent amaurosis, intermittent ophthalmia, &c.; all of which probably depend, for their specific character, upon the vegetable miasmata that lay the foundation of intermittent and remittent fever (§ 150, 650, &c.). Such has been the opinion of those who have lived and written in the midst of such affections. "The same cause," says Tissot, "which produces the intermittent fever, frequently occasions also disorders that return periodically at the same hour, without shivering, without heat, and often without any quickness of the pulse. Such disorders generally observe the intermissions of the quotidian or tertian fevers, but much more seldom those of quartans. I have seen violent vomitings, and retchings to vomit, with inexpressible anxiety, the severest oppressions, the most racking colics, dreadful palpitation and toothaches, pains in the head, and very often unaccountable pain over one eye, the eyelid, eyebrow, and temple, on the same side of the face, with a redness of that eye, and a continual trickling of tears. I have also seen such a prodigious swelling of the affected part, that the eye projected, or stood out, above an inch from the head, covered by the eyelid, which was also extremely inflated or puffed up. All these maladies begin precisely at a certain hour, last about the usual time of a fit, and terminate without any sensible evacuation, return exactly at the same hour the next day, or the next but one."

This reminds us of Hippocrates; and the practitioner in the malarious districts of the United States will not fail to recognize in the graphic portrait the same things in his almost daily walks, as he does in the "epidemics" of the venerated father of medicine.

The treatment of the foregoing cases is very embarrassing, unless we are prepared by a knowledge of their peculiar pathological character; and, having quoted the experience of Tissot as to their occurrence, I cannot do better than to state the treatment which was pursued by one who is so eminently entitled to our confidence; especially as that treatment has not been improved.

If the affection was decidedly inflammatory, as in the case of the eye, he abstracted blood. Then he goes on to remark that, "There is but one medicine that can effectually oppose these periodical maladies, which is the bark. Nothing affords relief in the fit, and no other medicine ever suspends or puts it off. But, I have cured some of these disorders with the bark, and especially those affecting the eyes, which happen oftener than the other conditions, after their duration for many weeks, and after the ineffectual use of bleeding, purging, baths, blisters, and a great number of other remedies. If a proper quantity of it be given, the next fit is very mild; the second is prevented, and I never saw a relapse in these cases, as often happens with intermittent fevers." But Tissot had, also, a preliminary treatment.

Tissot wrote before arsenic had come into use as a remedy for intermittent fever, and which has been subsequently employed with great success for the intermitting headache, &c.

892, *q*. There is one form of continued fever to which the bark is adapted in its advanced stages, and, what is remarkable, the tincture is often the best, and that, too, where stupor has come on, along with subsultus tendinum, black tongue, sordes, &c. This form of the continued fever is the typhus, and belongs to climates where the intermitting diseases are scarcely known to occur.* In these cases, the

* I have shown in the *Med. and Phys. Comm.* (vol. 2, pp. 449, 690) that *typhus* or *typhoid* fever does not originate in the U. S. south of Lat. 41°. The "*fatal typhoid*" of our civil war is the *congestive remittent* fever.—August.—1862.—NOTE S p. 1124.

bark appears to act both as a tonic and febrifuge. But, it is suited only to advanced stages of the disease.

892, *r*. Whenever cinchona, or its alkaloids, prove beneficial under other circumstances than such as have been stated in the foregoing sections they operate in virtue of their tonic property. But, like all other tonics their range of usefulness, in this acceptation, is very limited; being suited only to advanced stages of acute disease, or to some chronic maladies in which digestion is peculiarly impaired, or to others attended by profuse mucous discharges, as in old and excessive bronchial secretion, old diarrhœas, &c. Their best effects as tonics are probably manifested in feeble scrofulous habits, when digestion is impaired; and along, perhaps, with iodine. They exert, also, a kindly influence upon the shattered constitutions of old venereal subjects, especially when mercury fails of its usual office, and then, also, iodine should often go with it. They are among the present helps to broken-down debauchees.

Notwithstanding, however, the inconsiderable advantages that arise from cinchona as a tonic, it stands at the head of that group of remedies, as it does in its rank among the special alteratives for intermittent diseases. The contrast in effects separates very widely from each other these coexisting virtues, while the limited advantages of one or its more frequent pernicious effects tell us, forcibly, to beware of the whole group of tonics.

ARSENIOUS ACID.

892¼, *a*. Arsenious acid, in the treatment of intermittent diseases, has been rapidly passing into the great reservoir of forgotten things; whither it has been driven by the power of novelty, and the superior excellencies of the cinchona alkaloids. But, it remains as ever a sure friend of man whenever his necessities may oblige him to call it from obscurity. It is partly from these considerations, and in part to look at its peculiar attributes as a curative agent, and thus to elicit new rays of light upon organic life and the philosophy of medicine, that I shall venture to disturb the repose of this once busy member of the mineral kingdom.

But, these objects need not detain us long, as I contemplate a reference mostly to its relations to intermittent diseases; and much of what was said of cinchona is applicable to arsenic. This agent, however, is not complicated by any tonic virtue, as otherwise supposed by many, which divests it of objections that are relative to that characteristic of cinchona.* Yet, it has the attribute of a violent poison, and may, therefore, be liable to disastrous effects from its incautious use. But, with this contingent objection the amount of evil which it has inflicted is insignificant with that which is constantly in progress from the untimely application of the Peruvian bark, or from its excessive administration. In one case the immediate evils are less striking, or creep slowly on; in the other it is death itself who stands before us.

892¼, *b*. Arsenious acid appears to be more or less poisonous to all animals. In its therapeutical dose it produces no apparent effect upon man in health; which is only one of the numerous facts that admonish us against all conclusions as to remedial agents from what may be witnessed of their effects upon the healthy system, and to give

* The supposed *tonic* virtue of arsenic is predicated mostly of Voght's experiments on broken down horses, which have been incorporated into medical philosophy (§ 854 *bb*, 892¼ *i*, *k*).

our attention to the properties of life as their susceptibilities may be affected in disease (§ 150, 854, 870 *aa*, 892½ *a*).

In respect to the manifestations of arsenic in morbid states of the body, independently of its curative effects, they may be sufficiently learned from a statement by Dr. Fowler, that, "in 320 cases, somewhat more than one third was attended with nausea; nearly one third with an open body; and about one third with griping. Vomiting, purgings, swellings, and loss of appetite were but rare in comparison with the preceding effects, and their less frequent occurrence was generally found in the order in which they are here enumerated. About one fifth of the cases attended with nausea, and one fourth of those attended by an open body, were unconnected with any other effects. Griping did not often occur alone. Purging and loss of appetite seldom or never alone, and vomiting was always accompanied with more or less nausea."

The foregoing observations unfold the nature of the general influences which may be more or less expected from the therapeutical dose of arsenic, and illustrate the fluctuating nature of the organic properties. Such effects, however, may be generally avoided (§ 857).

892¼, *c*. Fowler's Report upon the effects of arsenic appeared in 1786, and subsequent experience has amply established its febrifuge virtue. It appears, indeed, to have succeeded not only occasionally in the hands of most practitioners of experience where the bark and its alkaloids have failed, but even upon an extensive scale in certain epidemical intermittents. It owes, in fact, its early reputation considerably to its success in an intermittent fever which infested Great Britain about the year 1780, and which prevailed for more than two years. But, it was the obstinacy, more than the great prevalence of this epidemic, which renders it memorable; and this the more so from its resistance of the bark, and its submission to arsenic. This was one of the occasions in which the bark fell into considerable disrepute; and we now comprehend the reason of its frequent failure during the epidemic of which I am speaking. Bloodletting was not then the fashion in Great Britain, and this fever was attended by those local congestions and inflammations which either demand the loss of blood, or, at least, render it necessary to any safety in the early administration of bark. But this tonic febrifuge was administered without the requisite advantages of a preliminary treatment, and the local conditions of disease were accordingly exasperated, the fever aggravated and prolonged, and often rendered fatal by the very remedy upon which there was the sole reliance (§ 847 *g*, 848, 854 *bb*, 857, 863 *d*, 870 *aa*).

However, therefore, the bark may have been thus baffled in its effects as a febrifuge, and inflicted the evils of a tonic, it was no fault of the remedy, but of the practitioners, who neglected the true pathology of the disease, overlooked the local developments, and permitted their prejudices against bloodletting and cathartics to deprive them of the benefits which might have accrued from the Peruvian febrifuge. Being thus baffled in their attempts with an agent of tonic virtues, a few practitioners availed themselves of the reputation which arsenic had obtained in Poland as a febrifuge; and this substance being destitute of the tonic and stimulant virtues of cinchona, it was more compatible with the local condition of disease, and therefore succeeded in the

hands of those few better than the bark. It was apt, however, to occasion vomiting and purging; but these effects were mostly the consequence of a neglect of the appropriate means for subduing the force of the local burdens of disease.

Parallel with the foregoing is an opinion which is thus stated by Dr. Sigmond.

"The effects of arsenic are much more striking in the intermittent fever occurring during the autumnal months, than during that which is prevalent in the spring; and the more intensely the miasm has acted upon the system, the more decided are its good effects, while cinchona, and the barks of certain trees, produce their characteristic effects during the spring."—SIGMOND'S *Lectures*, 1837.

I have quoted this remark for the purpose of carrying out the views which I have expressed as to the failure of the bark in the English epidemics, and as it is its tendency, also, to encourage the use of arsenic in the autumnal intermittents, without any just ground for the conclusion as to its superiority over the bark in the fevers of that season. The greater success of arsenic as here stated has been observed only in the hands of those who administer the bark indiscreetly, and without properly subduing the local congestions and inflammations which are every where more common and severe in the autumnal than in the vernal intermittents. And, as one of the evidences that the greater success of arsenic, under the circumstances now stated, is due to the absence of the tonic and stimulant virtues of cinchona I may quote the remark from Pereira that, "It is not necessary to intermit the use of arsenic during the febrile paroxysm. In agues, accompanied with inflammatory conditions, where cinchona and quinia disagree, arsenic may, according to Dr. Brown, be sometimes admin istered with the best effects." It has, he says, no tonic virtue.

Immediately after the events of the British epidemic of which I had been speaking, Dr. Fowler appeared with his "arsenical solution," or the liquor potassæ arsenitis; which has been supposed by many to surpass the arsenious acid in its remedial virtues. This preparation became the means of establishing, rapidly, the character of the new agent all over Europe.

892$\frac{1}{4}$, *d*. The question arises, next, as to what conditions of intermittent fever arsenic is applicable in preference to cinchona. We have seen that the bark and its alkaloids are capable of surmounting the disease with great certainty and rapidity under its ordinary conditions when properly administered; and this qualification supposes that other remedies, such as bloodletting, and especially cathartics and antimonials, shall be brought into operation whenever demanded by the general or local symptoms. The disease, being thus treated according to its variable pathological conditions, and the Peruvian febrifuge withheld till its application is compatible with the pathological states as meliorated by the direct antiphlogistics, we may, un doubtedly, in almost all cases which are seen in their early stages, succeed completely with the alkaloids, and thus avoid a remedy, which, like arsenic, is liable to the objections of being fatal in the dose of a single grain, or of inducing violent symptoms, or of laying the foundation of other serious and even fatal affections, in its usual therapeutical doses, if administered in inauspicious conditions of the system, or when continued, under favorable circumstances, beyond a certain

period. These considerations leave no doubt, therefore, that the alkaloids should be first employed in every case of intermittents, whether they be of fever, or of those other local diseases having periodical paroxysms, as considered in sections relative to the bark. Such, indeed, were the conclusions of the soundest medical experience before the introduction of the cinchona alkaloids; and, while balancing the merits of these remedies we cannot too well consider the safety of one when employed with a proper reference to pathological conditions, and the dangers of the other, under all conditions, that are liable to accrue from over-doses. But this objection applies only to the careless, and may be predicated of many other remedies in common use. We must take the world, however, as it is, and not as it should be; and when, therefore, as in the case before us, a choice exists, let us banish the evil as far as the choice extends. It should still, however, be recollected that, in the case of the bark, a morbific virtue may be in operation in the therapeutical doses of that agent, while the same special virtue does not appertain to arsenic (§ 150, 847 *g*, 848, 859, 863 *d*).

It appears, therefore, that arsenic will be wanted mostly in neglected or badly-treated cases of intermittent fever; and the former will be more likely to yield to other means than the latter. In the neglected cases, disease can, at most, have been aggravated only by errors on the part of the patient, while art, with its powerful morbific agents, may lay the foundation of very intractable local maladies that shall impart great obstinacy to the constitutional disease, as unintermitting exciting causes (§ 659, *b*). Cases undoubtedly arise, also, at certain seasons of the year, such as the autumnal (§ 892¼ *c*), to which arsenic is better adapted than quinine, or where the latter may fail on account of its tonic virtue. Again, other cases sometimes present themselves at all seasons where the vegetable remedy fails under the most judicious treatment. This may be owing to very peculiar modifications of the pathological states, or to unusual affections of certain parts, or to some idiosyncrasy. In short, arsenic is the next remedy, appertaining to the group before us, which should be tried after the failure of cinchona. But, it by no means follows that agents from other groups may not be equally or more appropriate. It happens, frequently, in prolonged or badly-treated cases of intermittent fever where the liver or spleen becomes the seat of enlargements and indurations, that iodine may be employed very successfully in conjunction with quinine. The accession of these two agents to the Materia Medica has contributed, largely, in this as in other respects, to the facilities of art.

It has placed, indeed, the foregoing affections greatly under the control of either; and, what is very important, where the bark was inadmissible during the coexistence of fever with the chronic derangements, quinine is often adapted to both conditions; so only, the treatment be properly conducted in its other details. Iodine, however, is only appropriate after an ascendency is obtained by other remedies over the febrile state, and where the force of the local affections has so yielded that they inflict no exciting reflex nervous influences upon the organs of circulation. Otherwise, that intensity should be first moderated by leeching, blistering, low diet, &c. With this qualification, and in the absence of fever, iodine has contributed not a little toward the exclusion of arsenic from the treatment of agues.

In some of the conditions of which I have just spoken, arsenic is advantageously associated with quinia, or administered in the associated form of a salt.

892¼, *e*. We finally come to the conclusion that arsenic ranks next to cinchona in the certainty with which it overcomes intermittent fever. But, it is less certain, and less rapid in effect; and the objection which applies to it as an energetic poison in over-doses should hold it in reserve, to be employed only where cinchona, or quinine, properly administered, may fail. Such as may study disease in its philosophical aspects, taking a comprehensive survey of its varied pathological conditions, firmly resisting the prejudices which timidity or ignorance have heaped upon bloodletting, and who prescribe for the absolute conditions rather than for the name of a disease, will rarely find it necessary to have recourse to arsenic in the ordinary forms of intermittent fever.

892¼, *f*. It is not improbable, however, that this agent may be found more useful in the distinctly intermitting inflammations which accompany marsh fever. It is always difficult to adapt even a cinchona alkaloid to these inflammatory states, while it never fails to exasperate the inflammation if administered before a strong impression has been made by bloodletting and other antiphlogistics.

892¼, *g*. Intermitting headache is a more common form of periodical disease than inflammation, in which arsenic proves often useful, and frequently where cinchona has failed. And so, also, of periodic tic douloureux.

892¼, *h*. Besides the intermitting affections, there are others to which arsenic is well adapted, and which strikingly illustrate the profoundly alterative and comprehensive remedial virtues of this agent. These remaining conditions of disease are so evidently different from the intermitting, that I have reproduced the arsenical preparations in two other groups of remedies, in my Materia Medica. It is important, in the first place, to regard each remedial agent of two or more virtues as a whole, and to consider its operation under its compound aspect. But, in this state of complexity they cannot be brought into that practical use which is promoted by the method which I have projected of considering the various properties of remedies in an individual sense, and according to the prominent conditions of disease to which they are suited, and by associating under the several denominations of disease the various remedies adapted to them, and in the relative order of their therapeutical value, and, therefore, presenting under each denomination groups of remedies having certain remedial virtues analogous to each other, however they differ in other properties, or however different may be the special influences by which the various agents under any given denomination of disease establish those changes which give to Nature the recuperative start. In this manner a single compound remedy comes to be distributed into what is equivalent to several agents; each remedial adaptation to possess an individuality which distinguishes it from other remedial virtues that qualify the agent as a remedy for other morbid conditions. In this way, I say, we avoid a confusion which has prevailed so extensively from considering a remedy of compound virtues in its general aspect alone. We are led to an attentive examination of its several virtues, of their critical relations to different pathological conditions and thus

to acquire a more distinct apprehension of the properties of life, of the modus operandi of remedial agents, and of the laws which govern the organic being under all his conditions of health and disease.

892¼, *i*. The diseases which fall, more or less, under the power of arsenic, and which illustrate the extent of its remedial virtues beyond those which have been hitherto considered, consist of certain chronic eruptive affections of the skin, cancer, noli-me-tangere, chronic rheumatism, diseases of the bones, chorea, elephantiasis, &c. In some of these conditions, especially in cancer, it is applied externally as well as internally. Iodine has been also advantageously associated with arsenic in the treatment of some of these affections.

892¼, *k*. The variety of diseases to which arsenic is adapted, and its inertness upon the healthy body in its therapeutical doses, illustrate my doctrines of operation through alterative reflex nervous actions, and of the increased susceptibility of morbid states (§ 143 *c*, 222–233⅘, 500 *m*, 892 *b*, 892½ *v*, 900, 902, 1059).—NOTE L p. 1120.

IODINE.

892½, *a*. Considering the extensive and powerful nature of the alterative action of iodine, it is remarkable that in its small therapeutical doses it produces no well-marked effects upon the function of any organ in its healthy state. In this respect, therefore, it goes with arsenic, and the rest, in illustrating the nature of life, and in enforcing a limitation of inquiries into the therapeutical capabilities of remedial agents to morbid states of the body (§ 137 *d*, 150, 854 *bb*, 870 *aa*, 892¼ *b*). When its use is long continued, emaciation is said to have sometimes followed, and now and then a low state of gastro-enteritis has been supposed to have supervened when iodine has been employed in large doses. This, however, is considered a rare effect, and to depend upon the incautious use of the medicine. It has doubtless happened in morbidly irritable states of the alimentary canal (§ 137 *d*, 150). Lugol, who had great experience with iodine, says, that so far from even occasioning a wasting of the body it promotes growth, and increases the size of organs, in their healthy state. The nervous system is said, also, to have been occasionally disturbed, in natural states of the body, by therapeutical doses of iodine; attended by headache, giddiness, &c. But here, too, there had probably been an antecedent derangement of the alimentary canal, &c. It has been also laid to iodine, that it has occasioned a state of the system which merits a name significant of one of its morbific tendencies; and hence that of *iodism* has been associated with the remedy. This condition is marked by vomiting, purging, cramps, emaciation, fever, &c. But, I am apt to think that the fault, in these cases, is chargeable to maladministration. Others have affirmed that iodine has occasioned salivation; but this, also, is denied by others. In any event, such a result is extremely rare. Twelve grains, on an average, have been given daily for eighty days, making 960 grains, without any manifest effect. In excessive doses, however, iodine is capable of acting as an irritant poison; or, should disease be present, the whole aspect of the subject is changed. I have never witnessed any of these alleged effects.

A remedy, therefore, so exempt from all untoward action upon the healthy body, and, withal, as inoffensive when skilfully used in morbid states, yet capable of a vast range of the most important reme-

dial effects, must be regarded as an accession to the Materia Medica of great value.

892½, *b*. I have been thus led to consider the failures of iodine upon the body in a state of health, in its ordinary doses, for the purpose of contrasting them with some of the remarkable therapeutical influences of which iodine is capable, and to show how the vital states are changed in their relation to remedial agents by morbid states. This, however, may be equally instituted with many other very powerful remedies, even those which are liable to act upon morbid states, in their therapeutical doses, with the intensity of energetic poisons, or strike at other alarming maladies, yet manifest no sensible effects upon the healthy organism (§ 137 *d*, 150, 870 *aa*, 892¼ *b*, *k*, NOTE L p. 1120).

892½, *c*. Perhaps the most remarkable demonstration of which iodine is capable is in those latent forms of disease where nothing is present to denote the morbid state but some gradual change of organization. This is seen especially in bronchocele, for which affection it surpasses, greatly, any other remedy. And here it may be said, as indicative, in every aspect of the subject, of the vital philosophy of the operation of iodine, that it is often as efficient in most of the local forms of disease for which it is employed whether it be administered internally, or applied externally. It is also an important fact, of the same import, that the external application must be made over the region of the affected part, when disease is seated internally; in which respect its mode of action through a reflex nervous process borrows light from the modus operandi of counter-irritants. Its control over the ordinary form of bronchocele is thoroughly established, and where it has failed I have no doubt it has been generally owing to some defect in the treatment (§ 893 *a*, *c*, *e*, *m*, 905¾, 1059, 1088 *b*).

I say, the common form of bronchocele; for there are some conditions of the thyroid gland which nothing will reach; which is one of the endless exemplifications of the importance of addressing our remedies to the exact pathological condition. Now the true bronchocele is constituted by a low indolent action of an inflammatory nature, that which results in hypertrophy; better known at present as a "lesion of nutrition." To these lesions iodine is adapted; and, although it seek out the obstinate forms of disorganization, there are some morbid changes of the thyroid gland which have been mistaken for bronchocele where this agent has disappointed expectation, and has suffered the blame of another's fault. Among these intractable conditions are formations in the gland of other substances than deposits of lymph, such as stony and other concretions. Or, again, the organ takes on a scirrous condition. Or, at other times, it enlarges suddenly, and shows high vascular action, which ends in an effusion of serum; the gland becoming enlarged in consequence. But this condition is not apt to remain long; and, although it subside spontaneously, it is not amenable to iodine. The remedies consist of leeches, vesicants, &c.; and, if such treatment be applied to the indurated states of bronchocele, preliminary to the use of iodine, this remedy will not often fail of accomplishing the residue of the cure. It is also indispensable to subdue, in the first place, any attendant excitement of the general circulation, or functional derangement of the chylopoetic viscera. These, indeed, are important objects of attention, whatever be the nature of the disease for which iodine may be prescribed. The

external use of iodine, in the treatment of goître, is not less efficient than the internal; so that both methods may be associated. Or, where objections apply to the more constitutional mode, the local application is often admissible. But iodine will not, like the mercurials, extend its influence over the system through the medium of the skin. Its effect is then by local reflex nervous actions (§ 497, 893 *e*, 1059, 1088 *b*).

892½, *d*. Soon after the discovery of iodine Dr. Coindet applied it successfully to the cure of scrofula. His observations were soon followed up by others; so that the claims of the remedy became early established in respect to this most intractable disease. Numerous cases and memoirs were published, all tending to advance inquiry into the new and extraordinary agent; extraordinary as well in its relations to the inorganic as the organic world. It was early and successfully tried upon an extensive scale by Dr. Manson in various conditions of scrofula, scrofulous ophthalmia, &c.; employed both internally and externally. Then followed Lugol, attached to the hospital of St. Louis, who published three memoirs confirming the favorable report of his predecessors. This narrative seems to be due to the early founders of a remedy which has already bestowed incalculable blessings upon man; approaching even cinchona, since we had in arsenic, and numerous other means, pretty good substitutes for that. And now, when we pause for a moment over the countless numbers who have been already rescued from the grave by iodine alone, and when we attempt to think of the labyrinth of medical philosophy through which the enlightened physician directs, with so much relief to the whole race of man, the most potent, as well as the milder agents, of the Materia Medica,—ay, the *remedium principale* itself, what shall be said of that credulity of the public which reposes its confidence in the charlatan, or yields the Pæan triumph to an Apollo in surgery?

Lugol's authority is valuable. His experience has scarcely been improved. He employed the remedy internally and externally, and treated the various conditions to which scrofula is liable, from the simple glandular swelling, ulceration, abscess, &c., to its destructive effects upon the cartilages and bones. An exception, however, must, and probably always will, be made in respect to tuberculous phthisis. He prefers a solution of iodine with the iodide of potassium, in water. This he administered either in the form of drops, or largely diluted with water under the denomination of ioduretted mineral water. It has become, indeed, a standing formula; but to which there is the same objection as applies to all other analogous prescriptions. They all require variations in the relative proportions of their constituent parts, and lead to a neglect of the varying pathological states of a common form of disease (§ 150, 672, 673, 857, &c.). It is doubtful, however, whether the union of the iodide of potassium often increases the efficacy of the simple iodine; although the salt, being less energetic, is often better adapted to irritable states of the alimentary canal, or where the circulatory organs are liable to excitement. It is readily seen, therefore, that for this reason the iodide of potassium may be often united in variable proportions to the more active and irritating form of the remedy.

892½, *e*. It should be considered, however, in reviewing the favorable reports which have been made of a new remedy, that here, as in most other cases, other observers have been less successful with iodine;

though a general admission obtains that it is more useful in scrofulous affections, with the exception of phthisis, than any other agent. This, therefore, is sufficient to place it upon very high ground as it respects the most Protæan disease. There is much reason to think, however, that those who have been least successful have often failed from not having bestowed the same attention upon those general means of improving health, such as diet, warm clothing, exercise, &c., which are, of themselves, not unfrequently curative of scrofulous affections; as they are of syphilitic. When remedies are employed in any given disease for the cure of which they have acquired the reputation of specifics, we are often apt to rely too exclusively upon the supposed specific, and the remedy, in consequence, frequently fails when it would have succeeded under a proper regard for the subordinate means. Failure in this respect may turn the "specific" into a formidable foe, especially in active forms of disease (§ 137 *d*, 150, &c.).

Again, since the early day, recent to be sure, of the wonder-working power of iodine, the reputed pathology of scrofula has undergone a revolution; and where abstraction of blood, general or local, a non-stimulating diet, &c., were often considered necessary, especially in the primary stages of phthisis pulmonalis, a tonic and stimulant treatment has been erected upon the new doctrine (§ 4, 5½. Also, *Med. and Phys. Comm.*, vol. ii., p. 608–634, 743–746, 780–782). From my own observation, I can entertain no doubt that iodine is yet destined to yield a subordinate aid in the treatment of tuberculous phthisis; while it will rarely fail to aggravate the disease if employed before inflammation is brought under the discipline of the lancet, low diet, &c., or where the alimentary canal, or the system at large, is in an irritable state.—Note F p. 1114, Mm p. 1141.

892½, *f*. Thirdly. The power of iodine, and of its combinations, reaches yet farther, and more remarkably, perhaps, than as respects its control over bronchocele. It has often accomplished the removal of certain chronic affections which appeared to have been excluded from the reach of every other medical agent. This has been especially true of many cases of those affections which have run on to induration. Here it is that iodine illustrates its remarkable virtues as an alterative, in breaking up the most obstinate conditions of disease, changing entirely the long-established morbid action of those capillaries from which the deposition of a peculiarly modified condition of lymph arises, and which forms some of the worst enlargements and indurations short of carcinoma (§ 733 *f*, 738, 740 *a*, *b*); while, also, its sanative effect must extend to the absorbent system of the part, increasing its energy, and thus reducing the volume of the organ and restoring it to its natural state. Mercury, it is true, will accomplish this in some instances, but is comparatively inoperative, and they are beyond the reach of quinine.

So also in those chronic enlargements and indurations of the liver and spleen which form the sequelæ of intermittent and remittent fevers the Peruvian alterative finds a competitor in iodine, though they will now harmonize together (§ 892, *kk*). Mercury, too, in some of its forms, is also more or less applicable to these conditions. But, to iodine we look with greater confidence in the intractable shapes; and here we may not calculate much upon the cinchona alkaloids. Nevertheless, even here mercury may be often advantageously asso-

ciated with iodine; and this is particularly true of bad forms of hepatic induration. Iodine, however, is more apt to take in its therapeutical scope those enlargements of the spleen which are known as ague cakes. They have often yielded to its influence in this and in other countries; and sometimes, indeed, where the splenic induration has been independent of fever, and where quinia is powerless (§ 662 *a*, 813 *b*, 814, 816 *b*, 892 *kk*). Leeching often promotes their effect.

The uterus, in its former intractable indurations and enlargements, has frequently yielded of late to the alterative action of iodine. Even when of a bony hardness, and filling nearly the cavity of the pelvis, this condition of the uterus has given way to iodine in the space of six weeks, the volume of the organ reduced to the natural size, and the catamenia restored. Here the dependence was upon iodine alone; and justly so, since there was no local or constitutional inflammatory symptom to require the co-operation of a depletory treatment. But, in other examples, where more or less active inflammation has attended the uterine enlargements, local and general bloodletting, rest, low diet, &c., have been brought advantageously to the successful use of iodine (§ 855, 856). It is astonishing, too, with what rapidity these conditions of the uterus have given way; yielding entirely, in the most successful cases, within periods varying from six weeks to four months.

These uterine cases, like the ophthalmic, illustrate the safety and advantage of applying iodine directly to the affected part, wherever accessible; it being rubbed, in the form of an ointment, in the case of the uterus, upon the neck of that organ. This practice has succeeded especially where the neck of the uterus has been the special seat of induration, and of those hard tumors which are liable to run into ulceration.

Iodine has even made salutary impressions upon ovarian tumors; and here, also, it is mainly useful in the indurated enlargements of the ovaries, and probably little, if at all, in ovarian dropsy.

Leaving the uterine system for its associate mammary gland, we have many accounts of its partial success, at least, in those scirrous affections which put on some of the aspects of cancer, but without its malignancy; relieving the distress, and holding the disease in check; while even cancer itself, and in its ulcerated state, is said to have derived mitigation from the external use of iodine.

Few affections are more sad than enlargements and indurations of the prostate gland; and here, too, the sufferer has sometimes obtained relief from this remarkable agent, both from its internal and external use.

The parotid glands swell up and remain permanently enlarged and indurated after scarlatina, and from other transient causes; and the lymphatic glands become involved in the same way from sympathy with diseased states of the stomach, or from other causes not connected with the scrofulous diathesis. In all these cases, iodine is the most efficient agent; at least, in a general sense. But these are cases, also, for leeching; which not only greatly helps the restorative change, but imparts, also, greater efficacy to the iodine. Indeed, it is not unusual that repeated applications of leeches to these glandular tumors, although of an extremely indolent nature, will alone overthrow their morbid states, and disperse the whole affection. It is a common mode of treatment in my practice, and has often revealed an alterative influence of the remedy of which cupping is incapable (§ 893 *a*, *c*, *q*, 926).

892½, *g*. Iodine has been employed internally and externally, with various degrees of advantage, in chronic affections of the skin, such as lepra, ichthyosis, psoriasis, &c., and it has been applied in the same way to arrest the progress of phagedenic and other destructive ulcers, which often put on favorable changes under the local as well as constitutional effects of this agent; which is also equally true of bromine.

892½, *h*. Nor has secondary syphilis refused to yield to the power of iodine; and this, too, in cases where mercury has either failed, or has aggravated the affection. But, these cases are not common, and we should not be led away from the better remedy by rare examples of greater success from an agent which will commonly fail. Where iodine has succeeded in cases of this nature, without the co-operation of mercury, the syphilitic affection may have been under the influence of the scrofulous diathesis (§ 659, 662 *a*). Besides the internal proof concerned in these cases, the foregoing conclusion is strengthened by the emaciation, ulcerations of the skin and throat, and the inflammation of the bones and periosteum, which often attend cases where iodine has exerted an independent sway.

But iodine has succeeded most happily in syphilitic cases when combined with mercury; especially where syphilis has affected scrofulous subjects. But simple iodine, true to its great prerogative of overthrowing deep-seated mischief of chronic glandular inflammations, has been successfully applied to old venereal affections of the testicles, and to indolent buboes.

892½, *i*. Gonorrhœa and leucorrhœa, in their indolent states, have been successfully treated by iodine; especially so in scrofulous habits, when the relief it yields is more uniform than in other cases.

892½, *k*. I stated just now, that iodine has been more successful in real ovarian tumors than in simple ovarian dropsy; but other dropsical affections have not escaped the far-reaching virtues of this new agent; though I have not much to say in commendation of its efficacy on this score. As in many other affections, it is evident that iodine delights in the worst forms of dropsy, and is little disposed to grapple with those simple conditions which depend upon mere inflammation of the serous or cellular tissues. It makes its attack, rather, upon those dropsies which nothing else will reach; such as are symptomatic of organic affections of the liver, or kidneys, or spleen, or heart, &c., and where a low inflammation is instituted, sympathetically, in the serous tissue of the abdomen or thorax, as the immediate proximate cause, and kept up by the organic disease. And now we understand how it is that iodine will sometimes reach these most formidable dropsies, since it is the peculiar province of this agent to break up old organic lesions; and, in exerting this astonishing office in regard to the liver, &c., the cause which maintains the serous inflammation is removed, and the dropsical affection disappears as a consequence. Hence, again and again, the importance of looking well not only to the nature of the pathological cause, but to all the complications with which it may be attended, and their sympathetic relations to each other (§ 905).

892½, *l*. Iodine has been successfully employed as an emmenagogue by most of the physicians who have illustrated its uses. My own observation leads me to believe that it is mostly useful in restoring menstruation in subjects of a scrofulous diathesis; and here it will be sal-

utary, if not contra-indicated by irritable states of the stomach and intestines. But, even in such cases the iodide of starch, or the milder sponge, may be admissible; and this remark, it will be readily seen, is more or less applicable to other affections attended by morbid irritability of the gastro-intestinal mucous tissue.

The same agent is also entitled to much consideration as an indirect emmenagogue in all cases where suspended menstruation is complicated with chronic enlargements or indurations of any of the great internal viscera. In these instances the uterine affection is only symptomatic of graver disease, as, indeed, it may be said, in a majority of other cases, to depend upon a primary though only simple derangement of some other part, especially of the alimentary canal (§ 689 *l*, 905), the uterus being disturbed by reflected nervous actions.

892½, *m*. Chronic rheumatism has proved itself amenable, in some cases, to iodine. We shall find, however, much better remedies for rheumatism, in all its aspects. But, it is not remarkable that a power so sovereign in many other intractable maladies should sometimes succeed in whatever less difficult and somewhat analogous instances it may be brought to bear. It must be considered, also, that the scrofulous diathesis is common, and that here iodine is at home.

892½, *n*. In the form of iodine vapor the novelty is even held up as a remedy for pulmonary consumption by Sir C. Scudamore, Sir James Murray, and others. But, it is scarcely probable that this condition can be affected in any other way than through the constitutional method, and it may be expected that the vapor will share the fate of boiling tar, and the steam of the horse-stable.

892½, *o*. Gout has yielded to this potent but quiet remedy. The swellings of the joints have given way not only in chronic, but in some acute forms of the disease. Those practitioners who have employed it in the latter case are probably of them who cure the same disease with bark and wine, and it has been overrated in the former. With the same experimental views iodine has been administered in diabetes mellitus; but, whether it may be useful or detrimental in this disease will depend, clearly, upon the circumstances of each individual case; especially upon the state of the digestive organs, which take an important part in the pathology of diabetes (§ 1007 *c*).

892½, *p*. Iodine is employed by the surgeon for various local purposes, among which many forms of ill-conditioned ulcers are the most common. Here it often manifests its sanative influence, but more so when the cases justify its internal use. It were well, too, if these cases were oftener treated according to the precepts of medical phi losophy and the experience of sound physicians.

892½, *q*. The ioduretted bath has been overrated, and the proof is against the supposed absorption by the skin (§ 892½ *c*, 1088 *b*, *c*).

The details as to dose, &c., must be sought by the young inquirer in the appropriate books. There, too, he will find some useful combinations of this with other substances, which have been brought together by the chemist, who is always laying the profession under these high obligations. We shall not often want, however, more than the simple substance, the iodide of potassium, the iodide of mercury, and the iodide of starch. It is not improbable, also, that we may sometimes find in bromine, or some of its combinations, useful substitutes for iodine.

892½, *r*. I have spoken of the iodide of starch as suitable in many cases where the intestinal canal, or the system at large, is too irritable for the more active forms of iodine. But, I am apt to think that, in such cases, we may also fall back advantageously upon the vegetable æthiops, or upon the burnt sponge. They have done us service in former times, and may do it again.

It is certainly a curious fact, in the history of the Materia Medica, that the fucus vesiculosus and the sponge, one an unseemly weed of the ocean, and the other an anomalous organic being from the bottom of the Mediterranean, should have been applied to the relief of bronchocele and scrofula, and have led to the important supplement which the Materia Medica has enjoyed in the iodides and bromides. Nor is it less curious that a remedy for the same affections had been detected in the liver of the cod.

Although the day of these mysterious agents has passed away,—passed in their uses and their mystery,—it may be that exigencies may now and then commend to our notice their quiet influences; when we may depend upon it we shall find organic nature as undeviating in these low conditions of life as in all other objects within its comprehensive range. We shall always find iodine and bromine among these humble tenants of the deep; and, in doses of one drachm to four of the calcined preparations, we may depend upon results, if not as certain and speedy as those of iodine or bromine, at least such as will evince an efficient remedial power (§ 290, 350, nos. 25, 26, 26½, 28).

892½, *s*. It sometimes happens when iodine, or its compounds, irritate the intestinal canal, or the system at large, they may be rendered compatible by small quantities of morphia, or the extract of hyoscyamus, or of lettuce, &c. This interposition of narcotics, however, to promote the tolerance of iodine, demands great care; and the narcotic must not be detrimental if the iodine were not employed. But, it commonly happens, when iodine produces its salutary effects, that it improves the appetite, if it have been deficient; or, at least, does not impair it. In a general sense, also, if the subject have been thin he gains in flesh under its influence. These affirmations can be made of no other remedy, excepting bromine, of equal curative power. It is often, indeed, upon the digestive organs that the first salutary effects of iodine are manifested; as seen not only in the improvement of appetite and digestion, but in the more abundant elaboration of bile, and in a healthier aspect of the fecal discharges. Simultaneously, also, the bowels act more freely; and, when purging takes place during the use of iodine, it is probably often more from the redundant flow of bile which it has promoted than from the direct action of the remedy upon the intestinal canal.

892½, *t*. Here, then, through these effects upon the organs of digestion, we arrive at an interpretation of those salutary changes which are exerted upon parts remotely situated. It is either a direct sympathetic result, or the sympathetic consequence of the removal of disease from the abdominal viscera, by which the remote affections had been maintained, as expounded in § 226, 503, 524 *c*, 893 *a*, *c*, 905.

892½, *u*. In a general sense, it has been found that a non-stimulant diet promotes the salutary effects of iodine. This agent is, in itself, a stimulant to the circulation in most of the morbid states to which it is

applicable; and, while it heals by other virtues, its stimulant properties disqualify it for all active conditions of inflammation (§ 137 *d*, 143 *c*, 150, 151). It is therefore an object in the lower forms of inflammation which come within the range of iodine to avoid increasing the susceptibility to its stimulant virtues by stimulating food (§ 143 *c*, 556 *c*, 872 *a*). In such conditions, indeed, abstemiousness, in respect to food, is in itself directly curative (§ 150, 856, 863, 1007 *b–d*, 1008).

But, there are some conditions to which iodine is peculiarly suited, particularly bronchocele, when the general health is often sound, and when the ordinary diet may be pursued (§ 143 *c*, 150, 151, 892½ *a*). In most other affections to which iodine is adapted the general health is apt to be unsound, and the local affections of a distinctly inflammatory nature.

892½, *v*. When speaking of cinchona and other special remedies for specific forms of disease (§ 892 *b*), I endeavored to demonstrate not only their therapeutical effects through alterative reflex actions of the nervous system, but, by the variety of means leading to a common result, the absurdity of the humoral and chemical hypotheses, and I would now reproduce that section in connection with iodine; nor would it be less appropriate to the article upon arsenious acid (§ 892¼). The great variety of special forms of disease which iodine and arsenic will remove contributes to the demonstration (§ 892¼ *i*, 892⅘ *g*, 900, 902, 951 *c*).

ERGOT.

892⅔, *a*. The origin and special character of ergot have been only recently well determined. Many have supposed it to be a morbid conversion of the seed, produced by some insect. Others regard it as a parasitical fungus; and it is incorporated by them as a true plant in the genus selerotium. It has been shown, however, by Tessier, and others, that a part only of the grain sometimes becomes ergotized; which proves sufficiently that it is not a fungus. The stigma, too, often remains at the top, and the ergot, like the rye, is intimately connected with the receptacle. Other observations, more recently made, prove conclusively that the microscope has been at fault, even in this very visible and hard substance, in its report of parasitical fungi as constituting the ergotized rye (§ 83 *b*, 131). The ergot is now sufficiently shown to be a morbid degeneration of the rye.

892⅔, *b*. Ergot was introduced into regular practice, as a powerful agent for exciting uterine contractions during the process of labor, by the venerable JOHN STEARNS, M.D., of the city of New York, in a letter to Dr. Ackerly, in 1808; though it had been a popular means of expediting labor a century and a half ago, in Germany, Italy, and France.

This letter of Dr. Stearns has not often met the public eye, nor has that reward attended the service which it was the delight of darker ages to bestow upon the great benefactors of man. The letter, too, is interesting from the brevity with which it announces a most important discovery (new at least to the profession), for the perfect accuracy with which the effects are described, and for the precautions which Dr. Stearns had the sagacity to suggest as to the circumstances under which this agent should be administered, but which have been most strangely violated by others.

The brief statement, which has now grown into volumes, of the wonderful properties of ergot, and of the only known substance which is capable of exciting uterine contractions, contrasts in its brevity and modesty not less remarkably with the never-ending and inflated accounts which are often coming to us of worthless specifics, and more worthless speculations, than does the decisive power of ergot form an imposing contrast with the whole host of those pretended remedies which have fallen into oblivion, one after another, when their inefficiency has been proved by an adequate sacrifice of human life.

But let us once more call into light the original announcement. Thus the letter:

"In compliance with your request, I herewith transmit to you a sample of the *pulvis parturiens*, which I have been in the habit of using for several years with the most complete success. It expedites lingering parturition, and saves to the accoucheur a considerable portion of time, without producing any bad effect on the patient.

"The cases in which I have generally found this powder to be useful, are when the pains are lingering, or have wholly subsided, or are in any way incompetent to exclude the fœtus. Previous to its exhibition, it is of the utmost consequence to ascertain the presentation, and whether any preternatural obstruction prevent the delivery; as the violent and almost incessant action which it induces in the uterus precludes the possibility of turning. The pains induced by it are peculiarly forcing, though not accompanied by that distress and agony of which the patients frequently complain when the action is much less. My method of administering it is either in decoction or powder. Boil half a drachm of the powder in half a pint of water; and give one third every twenty minutes till the pains commence. In powder I give from five to ten grains. Some patients require larger doses, though I have generally found these sufficient.

"If the dose be larger, it will generally produce nausea and vomiting. In most cases you will be surprised with the suddenness of its operation. It is, therefore, necessary to be completely ready before you begin the medicine, as the urgency of the pains will allow you but a short time afterward. Other physicians who have administered it concur with me in the success of its operation.

"The *modus operandi* I feel incompetent to explain. At the same time that it augments the action of the uterus, it appears to relax the rigidity of the contracted muscular fibres.

"It is a vegetable, and appears to be a *spurious growth* of rye. On examining a granary where rye is stored, you will be able to procure a sufficient quantity among the grain. Rye which grows in low, wet, ground yields it in greatest abundance. I have no objection to your giving this any publicity you may think proper."—John Stearns, in *New York Medical Repository*, vol. xi., p. 308, 1808.

That is the whole; correct in every aspect, and without a practical improvement from that day to the present; unless it be an extension of some of the minor points which are embraced in the comprehensive statement of the discoverer. It may, therefore, stand as an admirable concentration of all the leading details relative to this great accession to the universal cause of humanity and medical science. It is the best general guide for the practitioner that can be devised, and had it been duly posted in medical journals and obstetrical works, in-

stead of some of its violations which have appeared from time to time it will be conceded, I cannot doubt, that I am not astray from the objects of the present work in bestowing an ample notice of the origin of an important remedy which stands alone in the natural world.

No sooner was this discovery announced than its value was proclaimed in different quarters, not only by a confirmation of the imputed virtues of ergot, but by an opposition to its use on account of those very attributes of the remedy. It was said to be dangerously violent in its uterine influences. And so it is, like all things else in their various relations to disease unless employed with a proper reference to "precaution" (§ 137 *d*, 143 *c*, 150, 151).

With others there was not a ready disposition to concede the merit of originality, and records were hunted up for the purpose of showing that ergot had been long before in the hands of the common people, about in the same way as had been the cow-pox before Jenner confirmed its protective power. But, whether the former was of any greater use than motherwort the profession had not troubled themselves to inquire.

Frightful accounts were also quoted of wide-spread and fatal epidemics, which had been commonly charged upon rye, of which ergot was supposed to be the insidious cause (§ 892¾, *l*). A more feeble conjecture was never assigned for epidemics; unless the hypothesis be excepted, that damaged rice was the cause of the malignant cholera in Asia and Europe, because the patients had "rice-water evacuations;" and, also, that the milk of cows in some of our Western States is the cause of a malignant form of miasmatic fever (*Med. and Physiolog. Comm.*, vol. i., p. 537–539).

Other writers entered the field against the new agent in other shapes; some of them denouncing the remedy as invariably fatal to mother and child, while others affirmed that it was as inert as rye itself.

But time puts all things right, though it may come too late for him who should reap the reward. Harvey lost all his practice because of the envy which was excited by his discovery of the circulation of the blood; and nothing but demonstration upon demonstration to the eyes of the multitude rescued Jenner from the execration which he received because he had been so unfortunate as to render a great service to his cotemporaries. Newton, too, was so annoyed by opposition that he regretted his pursuits, and has left, in consequence, his stamp upon the very front of Philosophy, that she is "a capricious maid." But there is this consolation, as Bacon has it—"The sweetest canticle is, '*Nunc dimittis*,' when a man hath obtained worthy ends and expectations. Death has this also, that it openeth the gate to good fame and extinguisheth envy: '*Extinctus amabitur idem.*'"

It was not so in the early ages of our art; and had Harvey, or Jenner, or Stearns, have lived at that remote period, temples would have overspread the land for the perpetuation of their names, and as grateful memorials for their services to the universal family of mankind.

892⅔, *c*. Ergot is poisonous to flies, leeches, and some other small animals. In very large quantities it is said to be destructive to dogs, cats, pigs, sheep, rabbits, fowls, &c. But this effect has been evidently overrated, since it appears that some ounces were necessary to affect rabbits and pigeons. Sheep are put down by Pereira, in his

Materia Medica, among the animals that are liable to be poisoned by ergot. But a little farther on he says that, "In 1811, twenty sheep ate together nine pounds of it daily for four weeks, without any ill effects. In another instance, twenty sheep consumed thirteen pounds and a half daily, for two months, without injury." And then as to other animals: "Thirty cows took together twenty-seven pounds daily, for three months, with impunity; and two fat cows took in addition nine pounds of ergot daily," with no ill effect whatever.

The same conflicting statements are made as to the effects of ergot on man in health; some affirming that in doses of half a drachm to two drachms it excites nausea, occasions pain in the head, dilated pupils, &c.; while other experimenters declare that it produces no effects whatever. This is probably the fact; since we have heard of only some very rare cases in which it has had any other effect upon the susceptible pregnant, or parturient female, than that of exciting uterine contractions. We may, therefore, conclude that the fractional number of some five or six cases in which delirium or stupor is said to have resulted from doses of half a drachm to two drachms was due to other causes; especially when it is considered that such affections of the head are not unusual with parturient women where no ergot has been exhibited.

Universal and large experience has settled the fact that ergot has no special influence on the nervous system, and that, in its therapeutical doses, at least, it is perfectly inoffensive when administered with the proper "precautions" that are relative to the uterine system. This consideration, therefore, imparts an inestimable value to the uterine agent; and the other attending circumstances go with iodine, arsenic, &c., in reprobating all conclusions as to the therapeutical virtues of any agent which are associated, as inductions, with its manifestations upon man in health, and especially upon the modified constitution of animals, or the yet greater modifications that are presented by vegetable life. There is no other agent known to possess virtues analogous to those of ergot, while, also, its only manifest influences are pronounced under special modified states of the uterus. But, perhaps you say, and truly, too, that other things will excite abortion, or sometimes hasten natural labor. But, in all such cases, the results depend on very different influences; on some violence inflicted on other parts, or some uterine or other malady which may be thus removed. Cantharides may have sometimes excited abortion; but, if this be true, it is practically useless, rare in the effect, and obnoxious to other palpable objections. The highest practical as well as philosophical considerations are every where involved in the principles now, again, under investigation (§ 137 *d*, 143 *c*, 150, 151, 650, 831, 836, 854 *bb*, 857, 859 *b*, 892 *c*, 892½ *b*, &c.).

892⅔, *d*. The next question which comes up relates to the circumstances under which the uterus is susceptible of the influences of this specific agent; for this *one* may be so regarded till others may appear which will accomplish the same results.

Such is the remarkable action of ergot after labor has been instituted, especially after the usual period of gestation, that it was natural, perhaps, to suppose that the agent can bring on the process by its own specific virtues (§ 143 *c*, 150, 151, 652 *c*, 863). Experiments have been accordingly made upon animals to ascertain whether abortion would be thus brought about; but Villeneuve, Warner, Chatard, and

others, have failed in all their attempts, whether the ergot be injected into the circulation, or administered by the stomach (§ 150, 151). But this would not prove that abortion may not be thus instituted in the human subject (§ 892⅔, *c*). And to show how deeply founded in nature are some of the important laws embraced in a former section (§ 150), it is worthy of remark that ergot commonly promotes the uterine contractions in dogs, cats, sheep, cows, deer, and, indeed, of all other animals, so far as tried, after natural labor has been for some time in progress; even where the uterus has become exhausted by its long-continued efforts.

As to the human female, there is probably not much doubt that ergot is capable of exciting abortion. The vital relations, in the pregnant state, are more or less in correspondence with the virtues of the agent (§ 143 *c*, 150, 189 *b*, 892⅔ *c*). The question is stated in the following manner by an adequate observer, and who believes in this remarkable virtue of the great uterine agent:

"Given," he says, "to excite abortion, or premature labor, ergot has sometimes failed to produce the desired effect. Hence many experienced accoucheurs have concluded that for this medicine to have any effect on the uterus it was necessary that the process of labor should have actually commenced. But, while we admit that it sometimes fails, we have abundant evidence to prove that it frequently succeeds." Other able observers testify to this fact; Müller, Ramsbotham, and other familiar names.

It is evident, too, that ergot is capable of acting upon the uterus, and of exciting contractions of the organ, in its unimpregnated state, when its susceptibilities are increased by disease (§ 143 *c*, 150, 151, 177, 189 *b*). Uterine polypi have been thus expelled, and menorrhagia arrested.

But, this ceases to be remarkable when it is considered how greatly changed is uterine irritability in a state of pregnancy; when the most trifling causes, such as lifting a chair, putting up window-curtains, sudden joy, sudden surprise, or grief, will rouse the muscular action of the impregnated uterus, and bring on abortion (§ 150, 151, 189 *b*, 227, 233, 233¾, 904 *d*). If we now add to the foregoing considerations the increasing tendency to abortion in proportion to the frequency of its occurrence, it may aid our philosophy of life in its general aspects, and concur with other facts in a specific illustration of what I have propounded as to the laws of *vital habit* (§ 535–567).

Our experimental knowledge, however, as to the ability of ergot to institute labor must be always limited; for opportunities must be rare in which a physician of any moral sense, and therefore of any reliable truth, would administer this, or any other agent, with a view to producing abortion. Even in the very limited number of cases where art is called upon for this solemn duty it rather seeks the mechanical method.

Connected with the difficulty of attaining an adequate knowledge of the power of ergot of inducing abortion (especially the extent of its power), are the numerous mistakes that have been made in respect to other supposed effects of this substance; particularly those which are relative to the epidemics, and which continue to be more or less ascribed to its malign influence. But, what is more to the present purpose is the important fact, that, although now as in the "epidemic"

times (p. 622), doubtless, rye largely compounded with ergot is habitually and very extensively consumed, we have never heard, as one of its evil consequences, that it has given rise to abortion. This undeniable truth, therefore, must settle the question, at least, as to any uniformity in this imputed effect of ergot, and turn our attention to the mechanical means when the interposition of art is required, and our scrutiny to other expedients in detecting the criminality of others. A right decision of the question is one of great interest, not only in a philosophical aspect, but on account of its practical bearings, and, also, in a medico-legal aspect.—NOTE A p. 1111.

892⅔, *e*. It may now be said to the young practitioner, that he should bear in mind that the expulsive efforts are made by the uterus, that all the devices of the lying-in chamber, such as straining, pulling, &c., are worse than useless, that the uterine contractions are increased in violence and frequency soon after the administration of ergot, and that they generally go on increasing till the birth is effected. Indeed, the parturient process sometimes continues, under the influence of the agent, for several minutes after the expulsion of the placenta; but it commonly ceases, so far as the ergot is concerned, after delivery is consummated (§ 150, 151, 652 *c*).

892⅔, *f*. The rapid and energetic action of the uterus led Dr. Stearns to say, that, among other things, it is "of the utmost consequence to ascertain whether any preternatural obstruction prevent the delivery;" and, from what is also said of the circumstances which justify the use of ergot, it is evident that the discoverer considered a full dilatation of the os uteri of indispensable importance to any thing like a safe result. He foresaw that the uterus might otherwise be ruptured, or the external parts lacerated, or the child destroyed by the rapidity with which its head would be forced along the yet rigid parts. He foresaw, I say, a violation of nature if the foregoing condition were not awaited. And how fearfully has this been verified in practice; especially as it regards the fœtus! Why the vast difference in results in the hands of different accoucheurs? Why the numerous cases of cerebral hemorrhage in still-born children, that have come up, of late, for the good of science? The question is readily expounded when we turn to those Essays in which it is affirmed that ergot may be administered when the mouth of the uterus has attained the diameter of half an inch! This has been recommended principally with a view to saving the time of the practitioner; and it opens to us the ground of the prejudices, which have sprung up in enlightened and more honest quarters, against the use of ergot when it can be possibly avoided. Where the safety of the mother does not require earlier interference, it is, doubtless, a good rule not to administer ergot till the head of the child has passed the brim of the pelvis, and the labor has become lingering.

If the remedy be delayed till the os uteri is well dilated, then, by an admirable concert of sympathy, the external parts will have either undergone a corresponding dilatation, or a tendency to an easy dilatation (§ 150, 151, 385, and *references*).

892⅔, *g*. "Previous to the exhibition of ergot," says the discoverer, "it is of the utmost consequence to ascertain the presentation;" and now the only question that arises is relative to the admissible presentations. The os uteri is, of course, supposed to be fully dilated; and it

appears to be conceded that ergot may be employed when the head is turned from its usual position. But, this is not auspicious. Breach presentations admit of its use where labor has become prolonged, and the pains suspended; though here manual aid may be safely applied without the forceps. These instruments are always difficult but in the hand of experience, and are otherwise more or less liable to objection.

892⅔, *h*. It is not alone in protracted labors, where the uterine efforts have ceased to be efficient, that ergot is applicable with a view to promoting delivery. Serious hemorrhages sometimes spring up, where it becomes important to hasten delivery by every possible means that may be less hazardous than the impending evil. In cases of this nature, especially when alarming hemorrhage comes on during natural labor, and the attachment of the placenta is right, we enjoy no means so likely to insure safety and immediate success as offered by ergot; so only the pelvis be not deformed, and the presentation suitable.

892⅔, *i*. So, also, in ordinary cases of abortion, where hemorrhage may become alarming, ergot may be employed to hasten the expulsion of the ovum, and arrest the flow of blood. In these instances, however, the tampon is probably preferable, since it is always sure, and it is not certain that abortion will happen.

892⅔, *k*. Some females are remarkably liable to profuse uterine hemorrhage after natural labor; and these are cases for the administration of ergot a few minutes before the expulsion of the child; whatever may be the activity of the uterine contractions. In such instances it is not unusual for the pains to be quite energetic throughout the labor, but to cease abruptly as soon as the child is born. The advantage of ergot, therefore, administered some fifteen or twenty minutes before birth takes place, consists in its disposition to maintain the uterine contractions till the organ is so reduced in volume that hemorrhage is prevented or arrested.

892⅔, *l*. Again, where the forceps cannot be used in puerperal convulsions, ergot may be rendered a valuable substitute. The objections which have been made to its use in this condition, on the ground of its tendency to affect the head, appear to be hypothetical. In any thing like its therapeutical doses, the common experience of mankind has fully settled the fact that it has no tendency to induce or to increase cerebral or any other condition of disease, excepting as it may increase convulsions sympathetically through its uterine influences.

The erudite Pereira, in his Materia Medica, pauses over the exhibition of ergot in puerperal convulsions, because, as he says, "The *narcotic* operation of ergot presents a serious objection to its use in cerebral affections" (§ 960, *a*).

There existed a remarkable prejudice against ergot throughout Great Britain, for many years after it had come into extensive use in other countries, on account of the stories about its having produced wide-spread epidemics at former periods. Indeed, it was not employed, I think, in England, till the year 1824, or about sixteen years after it was in successful use in America. Some of the old prejudices remain in Great Britain, and where they exist the risk of that formidable affection, puerperal convulsions, will be taken sooner than one of its most efficient means of relief will be employed. We need not inquire, in the foregoing cases, whether the os uteri be dilated, so

only labor have fairly begun. But, we may not precipitate ourselves at once upon ergot. There is something else to be done first. The patient, I say, should be first thoroughly bled, as a preliminary requisite, not only on account of the cerebral affection, but to place the whole genital organism in a most favorable state for a ready expulsion of the child. Let each remedy come in its appropriate place. A violation of their proper order of sequence may be fatal, and doubtless has been (§ 960, *a*). The specific, as it is called, is, or should be, often the last in the consecutive series. If cerebral disease be not first moderated by loss of blood, the increased uterine irritation occasioned by ergot cannot fail to increase the evil in the head of which it had been the sympathetic cause. But, loss of blood strikes both at cerebral and uterine disorder. Nor have I any doubt that, where any cerebral symptoms have sprung up after the employment of ergot in its therapeutical doses, they have been due either to entirely different causes, or to the use of the agent at so early a stage of labor that an injurious violence has been inflicted on the uterus, and thus sympathetically upon the nervous centres (§ 230). There has been great rashness in the use of ergot, from an unnatural haste of some practitioners to get rid of their patients in one way or another. It is this haste which I would reprobate, as, also, a careless administration of ergot without a due reference to a proper state of the local requisites, and its employment in such excessive doses as render uterine action injuriously violent (§ 878). In such instances, we need not be surprised at any untoward result; and, if the uterus be ruptured, or the child destroyed, or the nervous system shaken at its centre, we may not blame the remedy.

$892\frac{2}{3}$, *m*. In cases where the placenta is retained from want of proper uterine contractions, ergot, if employed soon after the birth of the child, rarely fails of its purpose. The longer, however, its administration is delayed, the less likely will it be to reproduce the uterine contractions. Nature has accomplished her great purpose after the expulsion of the child; and if, from artificial influences upon the human constitution, she pause at her remaining office, it may often be that she is prematurely started upon her recuperative process, in which she now makes all haste to her wonted station. But, whether so or not, experience assures us that uterine irritability undergoes changes very rapidly after the expulsion of the fœtus, and that, in the same ratio, the reflected nervous influences induced by ergot fail of acting upon the muscular tissue of the organ (§ 150, 151).

$892\frac{2}{3}$, *n*. Where retention of the placenta depends upon spasmodic action of the uterus, or is owing to morbid adhesions, ergot yields no benefit, and may be injurious. The former condition certainly constitutes a serious objection to its use. The reason is, that one part of the organ is now in a more irritable state than the rest, and ergot, therefore, will act with unequal effect and increase the spasm; just as a cathartic will increase spasm of the intestine which depends upon some inflamed portion of the mucous tissue of that organ (§ 150, 151).

$892\frac{2}{3}$, *o*. Our parturient agent has shown itself capable of arresting uterine hemorrhage in the unimpregnated state, and that it is a useful agent in menorrhagia. Here it displays another attribute, and yet another differing from the astringent virtue. It does not now act as in the foregoing cases, as is evident from its failure of inducing any

of the phenomena of uterine contraction, while, moreover, the uterus is already in its contracted state. Its effect, in these cases, is like that of common salt, or of ipecacuanha, in restraining hæmoptysis. That is to say, of the individual substances, each one exerts some change in the action of the part peculiar to itself, but differing more or less from that of astringents, by which the secretion of blood is arrested (§ 904 *d*, 890, *a*).

Again, it is said that ergot has been successfully employed in hemorrhages from the stomach, intestine, lungs, nose, and gums; all of which concurs in farther illustrating the modus operandi of the pure astringents, and of ergot in restraining menorrhagia. It should be added, however, that the anti-hemorrhagic effect of ergot, except as it respects the uterus, has been overrated.

892⅔ *p*. All the foregoing effects of ergot, from its excitement of uterine contractions to its restraint over hemorrhage, are demonstrative of its operation through reflex action of the nervous system, and, with a multitude of other things which I have brought to the attention of the reader, supply a ground of analogical induction as to the *modus operandi* of all other remedies (§ 893½).—NOTE A, on the *cause of Labor*.

EMMENAGOGUES.

892⅔, *q*. In the foregoing sections I have been so near upon emmenagogues, and as the right treatment of amenorrhœa concerns so nearly a vast number of important cases, I shall briefly state the results of my own observation in connection with this subject, and with a view, also, of multiplying illustrations of the principles which form the ground-work of these Institutes.

Emmenagogues are arranged in my Materia Medica under the general denomination of *Uterine Agents*, of which ergot is the first, cantharides the second, and guaiacum the third in importance. I dropped the usual denomination which appears in this section, partly with a view of moderating a common belief that suspended menstruation is to be always treated by some agent bearing the name of an emmenagogue, as the name *chlorosis* leads to medication of the blood.

All the agents comprised in this group possess virtues that exercise, more or less, extensive though various influences upon the uterine system. In consideration of this known relation, such of them as have received the appellation of emmenagogues (of which cantharides and guaiacum are the principal) are apt to be employed with a reference alone to the prominent symptoms attending amenorrhœa. But, when the failure of the uterine function stands by itself, all the emmenagogues may be inapplicable on account of some special morbid state of the uterus upon which the cessation of the discharge depends. They are always contra-indicated, cantharides and guaiacum especially, in all inflammatory and irritable states of the uterus; at least, till these conditions are overcome by antiphlogistic means They are also inadmissible where menstruation is only suspended by some direct influences, as from exposure to cold, &c.; and they are positively injurious where the suspension depends upon sympathetic influences propagated by some active form of disease in other organs.

892⅔, *r*. In a large proportion of cases amenorrhœa is consequent on chronic maladies of the chylopoietic viscera, when uterine remedies are often administered with reference to the remote consequence;

and the condition of the important organs in which the uterine embarrassment had its origin, and by which it is commonly maintained, is apt to be overlooked or neglected. Where, however, the abdominal derangements are sufficiently pronounced to attract attention, it is not less common to look upon these primary causes as the results of a mere failure of the uterus to excrete its natural product. This interpretation comes of the humoral pathology, and is one of the every-day practical illustrations of the amount of its philosophy.

But, menstruation has a totally different final cause than humoralism imagines (§ 428–432). The evils which are imputed to a failure of the evacuation depend but little upon this circumstance. They are due, on the contrary, to the morbid state of the organ through which the excretion fails; and this condition is various in its pathological nature. According, also, to the pathological state of the uterus, other things being equal, will be the nature and amount of its disturbing reflex nervous influences. In a large proportion of cases, however, the uterus suffers but little, and its function returns as soon as the remote influences are overcome.

Hence, it is obvious that the main treatment should be addressed to the organs of the abdomen in all the cases included in this section. The state of the uterus, it is true, reacts upon the primary and leading seats of disease; but generally feebly (§ 905, *a*). Local means should, therefore, go along with the more constitutional ones; such as leeching the perineum, exercise on horseback, the hip-bath, &c., according to the general nature of the case.

892⅔, *s*. The foregoing view of our subject inculcates a variety of treatment in the multifarious aspects of amenorrhœa, and regards all things as emmenagogue, in principle, which will restore the uterine function; though that be commonly one of the least important effects. A cathartic may be best when menstruation is suddenly arrested by exposure to the cold, or a hot bowl of motherwort may do as well. Bloodletting is the main remedy when amenorrhœa is owing to inflammation or congestion of the uterus, whether it be primary or secondary. Exercise in the open air, especially on horseback, chalybeate tonics, mercurial and aloetic laxatives, a well-regulated diet, &c., are the means when it is dependent on indigestion (§ 892½ *v*).

892⅔, *t*. Having accomplished the leading intentions in the chronic forms of amenorrhœa, if the uterus still fail of excreting the menses, those agents which are known as emmenagogues may then be called into use; and of these, cantharides, administered till slight strangury takes place, is not only the most efficient, but far the safest. Guaiacum is liable to irritate the stomach injuriously, and to stimulate, unfavorably, the whole system, and especially the uterus. There are many cases, however, in which the uterus may ultimately require this peculiar irritation, or where certain states of constipation will yield, happily, to the action of guaiacum; but they require a sounder reference to the exact condition of the organ than when cantharides is employed. The uterus, indeed, is so liable to an interruption of its menstrual function that slight degrees of indigestion will occasion its failure; and in these cases cantharides will generally be entirely compatible with the abdominal affection, and sufficient in itself to re-establish menstruation. This variety of things leading to a specific result can be expounded only through alterative reflex actions of the nervous system (*See* GENITO-URINARY AGENTS, p. 683–689).

DIURETICS.

892¾, *a*. Diuretics are agents which increase the urinary discharge, and are employed either for that purpose specifically, or more commonly with an indirect reference to dropsical affections, upon which they are supposed to operate by promoting the absorption of the fluid and its excretion by way of the kidneys.

892¾, *b*. On looking over this group of remedies, it will be at once seen that it is obnoxious to objections which I have made to other groups, and that, as in the former cases, the denomination of diuretics must be received with special qualifications. Many remedies, also, are not embraced in the group which are capable of producing, under particular circumstances of disease, the most powerful diuretic effect. This is especially true of cathartics, and of some of them to so great an extent as to have procured for them the appellation of hydrogogue cathartics, or such as are capable of expelling dropsical effusions. Indeed, I may say that cathartics are better entitled to the name of diuretics than any other group of remedies; since no one of them operates upon the intestine without very generally increasing the excretion of urine; and, as to their relative effect in subduing dropsical affections, they greatly surpass the diuretics proper. The latter agents scarcely extend their influences beyond the kidneys; while cathartics accomplish their work as diuretics by overcoming the diseases upon which dropsical effusions depend, and by thus, also, withdrawing morbific reflex nervous actions which those or other diseases inflict upon the kidneys, and, thirdly, by exciting the kidneys to a freer production of urine (§ 227, 422 *b*, 423, 516 *d*, no. 6, 524 *c*, 889 *a*, 891½ *k*, 892½ *k*, *t*).

These remarks relative to cathartics lead me to advert to their control over dropsical affections as one of the demonstrations that dropsy depends upon inflammatory conditions. That pathological cause being removed by the antiphlogistic virtues of cathartics, the redundant effusions cease. The *modus operandi* is shown in the last *references*.

Bloodletting, which is not among diuretic remedies, has often as great an effect as cathartics, often greater, in establishing a copious production of urine, where it has been greatly diminished or suspended. And, from what was just said of the pathology of dropsy, it should be the best remedy, as it certainly is, in the early stages of hydrothorax and ascites.

To exemplify yet farther the nature of diuretics, and whether one thing or another will determine an increased flow of urine, and to show that this is an insignificant result of all the agents that may be employed, and that it is to the seat and pathology of disease that all our prescriptions should refer,—keeping the attention there and away from the kidneys,—I may refer to what was said of the diuretic effect of iodine in a former section, and of its modus operandi in subduing dropsy (§ 892½, *k*, *t*. Also, last *references*).

Again, there is nothing more uniformly and powerfully diuretic than fear, which, in all its degrees and modifications, rarely fails to increase the urinary product; being, also, in its excessive operation, a most powerful sudorific, while it simultaneously determines the blood from the circumference to the centre. The boldest warrior is not without the universal instinctive principle which impels all animals to flee from danger. On the eve of battle, when most stimulated by

pride and the hope of victory, he shows that another principle is in powerful operation by the frequency with which he dismounts, or turns aside from the ranks, to let off troublesome accumulations of urine. And just so with man whenever dangers impend; whether they threaten his life, his limb, or his reputation. And so with any event in the success of which he has an immediate interest. All this, too, is equally true of animals; and it all conspires in showing that humoralism, and "dynamic" and "quantitive" chemistry, are upon the wrong track, and that as mental emotions can excite diuresis and perspiration only through *direct* nervous influence, so do physical causes by *reflex* nervous action upon the secerning vessels (§ 422 *b*, 1067).

But, there is a vast variety remaining of the foregoing nature. Take a modification of fear, as showing the delicate shades of difference among the passions, and how they correspond in their effects, and in their organic influences, with material agents. Thus, anxiety, which has fear for one of its elements, exerts, also, a like but modified effect upon man. So, again, jealousy, which results from the united operation of fear and love (§ 188½, *d*). Thus Sappho:

> "In dewy drops my limbs were chilled,
> My blood with gentle horrors thrilled,
> My feeble pulse forgot to play,
> I fainted, sunk, and died away."

And, coming to the pure element, love itself, we observe other coincidences with fear; especially as it respects perspiration. In excessive joy, also, we meet with another powerful diuretic, as, likewise, in the sympathy between man and man. But it is manifest, in all these cases, that each agent, each passion, produces influences peculiar to itself, each one in its individual or its compound aspect. It is variously illustrated in the following sections: 227, 228 *b*, 233¾, 234 *e*, 500 *c*, *g*, *k*, *n*, 512, 652 *c*, 827 *c*, 828 *a*, 844, 902 *g*, 904 *d*, and in other places; while it may be said, in respect to the passions, that we may discern in the different conditions of the perspirable matter, and in the different states of the skin, indications of different organic influences that are exerted by the nervous power, and carry the same conclusions to other parts which may be impressed in their organic states (§ 227, 228 *a*, &c.). The same is true, also, of those emotions which are awakened by physical influences. Certain odors prove diuretic to some and cathartic to others; and, as affirmed by Shakspeare,

> "——— others, when the bag-pipe sings i' th' nose,
> Cannot contain their urine for affection.
> Masterless passion sways it in the mood,
> Of what it likes or loathes."

The last is analogous in its philosophy to what is said of light in section 514, *l*. And as to offensive sounds, which fall under the same category, it is related by Dr. Fairfax that, "Mistress Raymond, whenever she hears it thunder, even afar off, begins to have a bodily distemper seize her. She grows faint, sick in her stomach, and ready to vomit. At the very coming over of the thunder, she falls into a downright cholera, and continues under a violent vomiting and purging as long as the tempest lasts. And thus hath it been with this gentlewoman from a girl." Beddoes speaks of analogous results. "At any moment," he says, "inflammation may be kindled in any part by some causes which we cannot distinguish; by others too subtle for

our senses, as, perhaps, by a thunder cloud passing over head" (§ 230, 828 *c*). Until the nature of lightning was understood, it was supposed that it corrupted the blood in such cases. But, later "experimental philosophy" has enabled the chemist to expound it in another way, and to the easy comprehension of most people (§ 349, *d*, *e*), while the few take a more circuitous method (§ 222–233¾, 500, 893–905), although at no little peril (§ 5½, *a*). Again, cold, applied suddenly to the surface of the body, is often a powerful diuretic (§ 422, 423). But, although neither this nor the preceding causes are ranked as diuretics, they are probably about as much entitled to this designation as those agents to which it is specifically appropriated (§ 844).

892¾, *c*. The agents and causes of which I have now spoken disclose the whole philosophy of the operation of such as are especially denominated diuretics, and place it mainly upon the ground of *direct* and *reflex* actions of the nervous system.—NOTE D p. 1114.

Whether, therefore, it be loss of blood, or cathartics, or cold applied to the surface, or the operation of fear, or other mental emotions, which increase the excretion of urine, they all do it by acting directly or indirectly upon the secreting vessels of the kidneys, and mostly by means of direct or reflex nervous action. Loss of blood may be directly exerted upon the organs, or it may be, as is generally true, through the instrumentality of the nervous system, by removing disease from some other part, as the liver (which is a common example), and which had sympathetically diminished the excretion of urine. The principles, as it respects the nervous power, and the change of organic actions, are the same with cold, fear, &c. Coming, lastly, to the diuretics proper, such as are truly remedial produce their effects, also, upon exactly the same principles (§ 277). Nevertheless, it is undoubted that certain substances of mild remedial virtues, especially such as are not offensive to the lacteals, or to the general organism, gain admittance more or less readily into the circulation; and, coming in contact with the kidneys, may stimulate, and increase the action of, these organs. Such, for example, are certain neutral salts. Probably the acetates of potass and soda may produce their effects upon the kidneys more or less in this way; though certainly, also, through the nervous influence when they prove cathartic. In respect to these two agents, however, the chemical and humoral theorists are not all satisfied with their general hypothesis (§ 278).—NOTE Z p. 1130.

Nor is it at all surprising that the functions of the skin and kidneys should be so readily affected by the nervous influence, as developed by the foregoing causes, mental and physical, when we consider the final causes of each of the organs, and that Nature has ordained for their fulfillment a great versatility of action, and that, therefore, morbific and remedial agents will operate variously, according to their several virtues, through that natural constitution of the organs (§ 423 513, 902 *f*, *g*). This consideration also lets us into the reason why the urine flows so abundantly after some fluids, such as gin (which contains the diuretic juniper), and in some cases before there can have been time for their incorporation with the blood; a fact, indeed, so often observed, that many physiologists have supposed that there must be some more direct communication between the stomach and bladder than by the ordinary route of the absorbents (§ 350, no. 94).

892¾, *d*. The "diuretics proper" are the least useful of all the an-

tiphlogistics; having but little effect upon inflammations or fevers. Yet are they often prescribed in high grades of those affections (where the urine is greatly deficient), in the vain expectation of reaching those profound lesions by the removal of one of their least important sympathetic consequences. Their use, however, with the more enlightened, is now mainly limited to dropsical effusions in the great cavities and the extremities; however defective may be the pathology, or however inefficient these agents are compared with bloodletting, cathartics, blisters, mercury, iodine, &c. They are always most useful in cases that are benefited by loss of blood and by cathartics (See as to heart in § 500 *m*, 685½, 687½, 694¾, 826 *cc*).

892¾, *e*. Some of the diuretics which possess compound virtues, such as squill, and Indian hemp (*apocynum cannabinum*), may prove very detrimental in many cases of dropsy; the former, for example, by its acrid, stimulating virtue, the latter by its severe action upon the intestinal canal. Where mercurial agents are employed, they should be well chosen, and according to the existing pathological states. In the simple form of dropsy, or if inflammation exist in any degree of activity, as in the serous tissue, or in the liver, then some one of the simple mercurials should be selected, as calomel, or blue pill; preceded, however, by loss of blood, &c. If, on the other hand, the dropsical effusion have existed a good while, or be attended by chronic enlargement of the liver, or of some other viscus, the mercurial should be chosen with reference to such organic affections; though calomel or blue pill may answer well. But, in these cases, the iodides and bromides of mercury are the most appropriate; and now we may, sooner or later, employ squill with or without other diuretics, though it is commonly most useful to combine two or more together. If the subject be of a scrofulous habit, iodine should be used freely.

892¾, *f*. Much has been said of the connection of renal disease with dropsy, and many physicians have, in consequence, gone into a chemical analysis of the urine, instead of the signs to be observed in the body, for an exposition of the nature of disease. But, so many coincidences have sprung up from other causes, that it may be expected that this "experimental philosophy" will not endure.

892¾, *g*. The greatest of all the errors in relation to dropsical affections is that which divides them into active and passive. This error appears to have grown out of another—that which makes the same distinction of inflammations (§ 752, &c.); though, in the former case, the relative states of pathology are supposed to be in even greater opposition. The practice proceeds upon the same hypothesis as that which concerns the distinctions in inflammation.

EXPECTORANTS.

892⅘, *a*. This group of agents has had too large a connection with disease to be neglected; or, at least, not to be held responsible for any mischief it may have done. Like many other denominations, the term is significant of their most visible effect, although, like many others, it is one of the least important in a large proportion of the diseases where they are employed, while the most important can be obtained only by remedies that do not fall within the group.

The tendency of the name, and the definition which is given of expectorants, have turned a great amount of attention upon the quantity

of matter expectorated, and away from those pathological conditions upon which the physical product depends (§ 889 *c*, 891 *d*, *o*).

It is greatly, therefore, with expectorants as with sudorifics, diuretics, &c. The secreted product is only a secondary result; complicated and various in respect to the conditions and influences by which it is brought about, and capable of being increased or produced, under different vital states of the body, by agents of entirely opposite virtues,—by the most direct sedatives, and by the most active stimulants. Every thing, therefore, which will, under any contingencies of disease, increase or produce expectoration, is more or less entitled to be considered an expectorant. Hence, it is apparent that, whenever remedies are applied with a view to the supposed objects of expectorants they are quite likely to aggravate formidable grades of disease, or to leave the subject, at least, to an unresisted fate which might have been averted by appropriate means.

892$\frac{4}{5}$, *b*. In my *Arrangement of the Materia Medica*, I have placed some agents, under the denomination of expectorants, as first in importance, which others, who consider mostly the result upon which the group has been founded, would rank lower down. But, as the foundation of my arrangement relates to the therapeutical capabilities of the various substances, I have designated tartarized antimony as the first, and ipecacuanha the second in importance. These agents, in a general sense, are most useful under the condition in which expectoration is desirable, if relief be not obtained without; though it may or may not be a result of their action. It is now, as when sweating may take place profusely, moderately, or not at all, from what are denominated sudorifics. But, I should say that the parallel does not hold strictly in these cases; since the sympathies between the stomach and skin are so far different from those which prevail between the stomach and the lungs, that mild impressions made upon the stomach, as by hot water, will determine profuse perspiration, or, as in other cases, irritating food will occasion, speedily, eruptions of the skin; while none but agents of considerable power will institute reflex nervous actions in the lungs, or give rise to that expectoration which grows out of such actions. All the expectorants, therefore, of any importance are capable of exerting powerful effects, either for good or for evil; while, of all the sudorifics, tartarized antimony and ipecacuanha are the only ones that are entitled to consideration on account of the alterative reflex nervous actions instituted by expectorants.

Reflex nervous actions, as excited by the operation of agents upon the stomach, depend not only upon the nature of the agents, the natural function of the sympathizing part, and the particular mode in which it may be affected by disease, but upon the analogies that may subsist in the structure and vital constitution of the mucous tissue of the stomach and the part remotely influenced (§ 133–152, 525–529). The group of remedies now before us refer to a tissue of the same species as that of the stomach upon which the remedial agents exert their direct effect; and reflex nervous actions upon the pulmonary mucous tissue, when induced by remedial agents applied to the stomach, are, for this reason in part, different from such as are exerted by the stomach upon the skin, and are generally much more profound, and of a more alterative nature.

892$\frac{4}{5}$, *c*. The effect of remedies, therefore, in their acceptation of

expectorants, being determined by the existing condition of disease, and more or less by the state of the system at large, and conditions not much allied admitting the agency of remedies that operate as expectorants, it is clear that we must have a classification of these remedies according to their general virtues. I have, therefore, more or less after the manner of others, distributed them into five subdivisions. These I shall now state, along with the several agents embraced under each subdivision; and, for the purpose of illustrating my conceptions of their relative bearing upon disease, and with only a secondary view to the expectoration which they may be, respectively, capable of producing, I shall designate each one by numbers that denote their order of arrangement, and their relative therapeutical uses where expectoration is a desirable consequence if the remedy do not succeed without.

Non-stimulating.—1. Potassæ antimonio-tartras. 2. Cephælis ipecacuanha. 4. Gillenia trifoliata. 6. Asclepias tuberosa.

Stimulating.—3. Scilla maritima. 7. Polygala senega. 8. Dorema ammoniacum. 10. Opoponax chironium. 13. Eryngium aquaticum. 14. Myrospermum toluiferum. 15. Myrospermum peruiferum. 16. Naphthaline. 17. Styrax benzoin. 18. Styrax officinale. 19. Liquidambar styraciflua. 20. Amyris gileadensis. 21. Allium sativum. 22. Erysimum alliaria. 23. Sisymbrium officinale.

Stimulating and Narcotic.—5. Sanguinaria canadensis.

Sedative and Narcotic.—11. Lobelia inflata.

Stimulating and Antispasmodic.—9. Ferula asafœtida. Ferula persica. 12. Galbanum officinale.

It will be seen, therefore, from the foregoing general distribution of expectorants, that four of them only are adapted to any thing like acute inflammation of any tissue of the lungs; and that the first two only are wanted. Moreover, none of the expectorants are employed as such excepting in some inflammatory state of those organs; or, at least, according to my views of all the pathological conditions for the relief of which the expectorants are intended. And when it is considered, also, how very irritable and susceptible the lungs are when affected in their parenchymatous structure, and even those parts of the mucous tissue which line the bronchi, larynx, and trachea; how liable, too, inflammation is to be propagated from the upper portions into the air-cells; how many there are in whom pulmonary phthisis is readily awakened by inflammatory states of this membrane; how they constantly throw morbific influences over the stomach, the intestine, the general organs of circulation, &c.; and how often inflammation of the tracheal portion of the membrane eventuates in ulceration; besides other sequelæ of inferior moment; it becomes apparent that this group of remedies, with the exception of the two leading members, has numbered its victims next after those agents which form the groups of tonics and stimulants.

Why, then, it is asked, perhaps, does the squill rank, in the arrangement, as the third in therapeutical value, and before the non-stimulant American ipecacuanha, bloodroot as the fifth, seneka the seventh, gum ammoniac the eighth, and these last three before asafetida, &c.? The answer is important, although the order of arrangement assumed that the reader was sufficiently conversant with the principles upon which it is founded. It assumed, in the first place, that he was famil-

iar with the general structure of the lungs, that he had some ideas about a "chemical" difference, at least, in the relations of different portions of the pulmonary mucous tissue to this group of remedies (§ 134–143); that he was aware of the inflammatory nature of the disease for which he was prescribing, as well as its exact seat; that he distinguished between acute and chronic forms of inflammation; that he understood, that, as one portion or another of the pulmonary mucous tissue might be the seat of disease, and according to the special modification of disease, it might be relieved or increased by different expectorants, and according, also, as the premises might be, he foresaw that this or that expectorant might develop tuberculous phthisis, or become the indirect cause of disease in other parts, &c.

Proceeding, therefore, upon these principles, and as chronic inflammation of the mucous tissue of the trachea and bronchi is a very common form of disease, and is often benefited, in constitutions that are otherwise sound, by a stimulating expectorant, it was important that some one, at least, should occupy a high place in the *Arrangement*. But, it should be also one whose virtues are most of an alterative nature, but most exempt from morbific tendencies; whence it becomes plain that the scilla maritima should stand immediately after the cephælis ipecacuanha. It should also precede the gillenia, since the virtues of this last, as, also, of the asclepias, are analogous to those of the great product of Brazil, yet much inferior. But, comparatively unimportant as the gillenia and asclepias may be, they are yet so analogous to ipecacuanha, that they may stand by its side, and being of easy access to the American practitioner, they should follow near upon the other two non-stimulant expectorants; gillenia taking the precedence of the asclepias on account of its greater alterative virtues.

Asafetida, I am aware, is a favorite expectorant with many; but it is less alterative than seneka, and the preceding gums, and is much more liable to offend the stomach.

As to bloodroot, that substance stands, like castor oil, alone in the Materia Medica. It is capable of peculiar influences; but, as they are oftener injurious than beneficial I have given to it a higher rank than was warranted by my own experience or by that of some others. It has been, however, highly commended; and in deference, therefore, to that more favorable experience, it appeared to me that it should occupy a place in the Arrangement that might yield to the remedy a fair opportunity for more ample observation of its effects, so far as my Arrangement might have any influence.

The foregoing analysis will serve, also, for the disposition which I have made of the members of all other groups. The arrangement bears upon its face the author's conceptions of their special relations either to pathological conditions that are most allied, or to such as are diverted from the common forms, or to others which are distinguished by greater peculiarities; while, also, the order of each one, under the various assemblages, denotes its therapeutical capabilities. If the author, therefore, be right in his premises upon which the arrangement is founded, each article is thus rendered more or less descriptive of its own uses, &c. (§ 892, *aa*, *c*).

892$\frac{4}{5}$, *d*. There should be no difficulty with correct observers in reaching a knowledge of the conditions of disease to which remedial agents of such various and even opposite virtues as the expectorants

are adapted. The general principles of pathology and therapeutics go far in indicating, at once, which of the groups are properly suited to certain pathological states, which of its members is best adapted to any modified condition of the general pathology, or which of the groups, or which members of the proper group, should be avoided. But, a nice discrimination of the variously-modified forms of inflammation, whether as to its nature, intensity, duration, complications, &c., and a precise acquaintance with the peculiarities of each remedial agent, will be often necessary to guide us to the just regulation of influences which any given combination of symptoms may demand; or, proceeding blindly to execute the results of an *expectorant*, in its ordinary acceptation, and under the belief that each substance so denominated will alike fulfill the intention, we may as readily destroy the patient, in the end, by this indiscriminate practice, as we might, with certainty, relieve him by a choice of other means bearing the same general name of expectorants. It is not, therefore, I say, the abstract fact of expectoration that we are to regard, but this is to be considered as a result of a favorable action which certain remedial agents are capable of instituting, but which very often fail of that result when their action is in the highest degree salubrious. On the contrary, also, we shall see that expectoration may be increased by increasing the morbid conditions; just as the discharge of mucus, in intestinal inflammation, is increased by an irritating cathartic. The only difference consists in the direct action of the morbific irritant upon the affected part, in one case, and by reflex action through the nervous power, in the other (§ 150, 151, 226, 228, 229). It is, therefore, far from being true that the remedy is appropriate when the discharge from the lungs is promoted and increased, even though an expectorant be especially indicated, and the proper one may also tend to lessen the quantity of mucus through such alterative influences as lessen the morbid action upon which it depends.

892$\frac{4}{5}$, *e*. We see, therefore, more and more, how indispensable it is to look upon results as indicative only of certain complex vital conditions which should be ascertained, and, as far as possible, to regard the proximate causes in all our prescriptions (§ 673, 674, 699, 741). Here we have a patient with a cough. A favorable or a fatal issue of his case may depend entirely upon the exhibition of the right expectorant. He may be cured by tartarized antimony, or may be killed by squill, seneka, or bloodroot. It is evident, therefore, that "coughs" depend upon important varieties of pathological conditions; though, when the direct result of pulmonary disease those conditions are generally of an inflammatory nature. There may be numerous gradations of the form of common inflammation from that which constitutes pneumonia, and speedily runs its course, to that indolent state which persists for years, and makes little or no impression upon the general health.

All this, however, is doubtless obvious to enlightened practitioners; but, when it is considered what morbid anatomy is about, even with common inflammation (§ 699), and, how deplorable the evils which have sprung from the pathology of scrofula and tuberculous phthisis that has issued from the purlieus of Paris, I am moved by the conviction that I cannot attempt a more useful service to humanity than by exploring the subject now under consideration.

It has been no uncommon and fatal error to have exhibited stimu-

lating expectorants (which, indeed, commonly form the "cough mixtures"), in active forms of pneumonia, under the belief that these stimulating agents possess the power of at all times producing expectoration, and that this result is the main object to be contemplated. Sometimes, however, these agents produce vomiting, and their effects are then less disastrous; or, in subdued forms of acute inflammation this sedative influence may barely counteract the stimulant virtue, or it may be useful. It is like employing snuff for nasal catarrh (§ 228 *a*).

892$\frac{4}{5}$, *f*. Coming to special modifications of inflammation, the expectorants in common use perform their morbific work according to the variety of the disease, and the part of the pulmonary mucous tissue, or other tissue of the lungs, in which it may hold its seat.

Readily as that modification which constitutes croup may be removed in its early stages, a pernicious custom exists of prescribing stimulating expectorants. It is true, they are often united with tartarized antimony in the treatment of this disease; and a formula of this kind exists in the United States Pharmacopœia, bearing the name of the *Compound Honey of Squill*. That may be well enough, unaccompanied with directions for its use, with the exception of the honey, which is of no use whatever, never fails to injure the stomach, and often produces colic in healthy people. But, the compound is *there*, however, with the obvious design of supplying a convenient resource to the practitioner in cases of "cough," and especially that which attends the croup. In Wood and Bache's Dispensatory, of which the United States Pharmacopœia forms an important basis, it is said by the editors, that it "requires an explanatory commentary, in order that its precepts may be fully appreciated, and advantageously put into practice." Now, after stating that formula, the editors remark, that "this is the preparation commonly known by the name of *Coxe's Hive Syrup*." Indeed, such is the translation of the original name. Thus:

"Mel Scillæ Compositum. U. S. *Compound Syrup of Squill. Hive Syrup*."

In this are four ounces, each, of squill and seneka, and two pounds of clarified honey, along with four pints of water and forty-eight grains of tartarized antimony, boiled down to three pints, or about three pounds.

Such, then, is a standing formula for croup, with the very name of the disease associated with it; and a more dangerous weapon was never put into the hands of the profession. Compared with the lancet, which is so often represented in a similar manner, the ratio is about the same as computed by Smith between the "hero and the murderer" (§ 569, *e*). In all the cases, however, the questions at issue are to be decided by the force of facts.—Notes F p. 1114, Mm p. 1141.

If the mischief attendant on the "Hive Syrup" were limited to croup alone, these remarks, perhaps, had never been written. But, "cough" upon "cough," reaching even to all the stages of pulmonary phthisis, make their frequent demands upon "Hive Syrup." The antimony which it embraces atones but little for the offenses of its associates in most of the cases where they are called into action.

892$\frac{4}{5}$, *g*. It is *resolution*, not expectoration, which is wanted, when it can be obtained, in all the cases of active inflammation,—ay, in all of pulmonary phthisis before suppuration supervenes (§ 700 *b*. 705,

732 *d*, 862–864, 890 *e*). If the disease be of such intensity that resolution may not be effected by tartarized antimony or ipecacuanha, no time should be lost in calling upon general or local bloodletting, cathartics, blisters, &c. And when we consider how these accomplish the intention to which the expectorants are inadequate only from the force of disease, it will go with the many other analogous considerations disseminated in this work toward clearing up the philosophy which interprets the operation of expectorants, whether in their curative or morbific relations to disease. Or, again, if bloodletting fail of arresting pneumonia, for example, we may pursue the philosophy in another aspect; since, while it has relieved the violence of the malady, it has brought on expectoration. It has so modified the inflammatory condition that mucus is generated in preternatural quantities; and therefore we see that bloodletting itself may operate as an expectorant. We now exhibit tartarized antimony, and it may either increase or diminish the expectoration; and, in doing either, it contributes to the decline of the disease. The expectoration, therefore, is a mere result, a mere symptom, of a certain change in the action of the organs by which the mucus is secreted; and it may be the result of a favorable or an unfavorable change. It appears, therefore, that whether the agent will or will not increase the mucous product, or, on the other hand, diminish it, depends upon the exact influence it may exert upon the pathological condition. All this clearly brings the operation of the several agents upon a par, and admonishes us to study their virtues, their mode of operating, and the precise conditions of disease to which one or the other may be applicable (§ 694¾, 741 *b*).

But, let us pursue yet farther the case of pneumonia. Let us suppose a slow termination of disease. Antimonials finally cease to bestow any farther benefit, and the cough has subsided into one of a low chronic nature, without much expectoration. Here it is, if there be no strong tendency to scrofula, that squill, seneka, and other stimulating expectorants, may become highly useful; and if the cough be frequent and short, denoting an irritable state of the lungs, we associate an opiate, which not only allays the cough and moderates the stimulant effect of the expectorants, but increases the expectoration; and thus the opiate becomes an expectorant, though neither this nor bloodletting are ranked in that group of remedies (§ 872 *a*, 891 *i*).

A blister is also applied to the affected chest, and now, again, expectoration either increases or declines; though, in either case, there is a manifest abatement of disease as a consequence of the counter-irritation (§ 111–117, 233⅘, 647½, 891½ *k*, 893 *a*, *c*, *e*, 905 *a*, 227).

But, perhaps the cough has ultimately become complicated with disordered digestion, or, it may be chiefly maintained by some gastric derangement. It is dry, and the usual expectorants render it still more irritating and husky. The remedy, therefore, is wrong, and has not been addressed to the essential pathological condition; which consists of some derangement of the stomach, while that of the lungs has become mostly sympathetic. Whatever will now relieve the former affection may remove the pulmonic. For this purpose tonics may be useful, and, as relief follows in the lungs, expectoration may be one of the results (§ 905). Tonics, therefore, in cases of this nature, become expectorants, and equally so as any of the agents which are confined to this denomination of remedies. It is obvious, too, that

they all operate upon common principles when they promote expectoration; and whether the result will follow one or the other, will depend upon the existing state of the system, in a general sense, and more particularly upon the precise pathological condition of the lungs. It is apparent, therefore, that remedies from almost any group may be expectorant; bloodletting, cathartics, emetics, narcotics, tonics, counter-irritants, and even alcohol. The last, indeed, in the form of hot toddy, is a popular remedy for colds. It may or may not increase expectoration. It may relieve, but more generally aggravates the disease (§ 756). Will Chemistry explain (§ 892 *b*, 892½ *v*)?

Old neglected coughs from ordinary catarrh, and what is known as the old man's cough, come under that condition of common inflammation to which the stimulating expectorants are adapted. But, however protracted may be the specific varieties, as in hooping-cough, and pulmonary phthisis, they cannot be employed without endangering life. Their effect, indeed, in hooping-cough is so obviously bad that they are not often employed in its treatment; but, in pulmonary phthisis, and especially in the catarrhal affections of scrofulous constitutions, we every day witness the penalties which are paid for substituting morbid anatomy for the vital signs of disease, and in defiance of the plainest demonstrations which therapeutical agents can supply (§ 137, *c*, 662 *a*).—NOTE F p. 1114.

892⅘, *h*. The sympathies to which the lungs are liable from many diseases of other parts, especially of the digestive organs, and the more or less reciprocal effects of their own diseases, by which endless reflex nervous actions may be set in operation, together with the situation of the lungs in a bony cavity, frequently render it difficult to ascertain their exact pathological conditions, and to distinguish what may appertain to pulmonary disease from what may be due to the play of sympathies. The stethescope, like the long-established method of percussion, has contributed much to clearing away the obscurities, and has done its good part in substituting pathological considerations for mere effects, and has shown us that cough, difficulty of breathing, &c., are not diseases, but merely symptoms of disease. The scientific physician, therefore, no longer administers expectorants, &c., for the relief of cough, or dyspnœa, but he applies the various agents to overcome pneumonia, pleuritis, bronchitis, laryngitis, pharyngitis, &c. In one case there is something tangible, intelligible, and susceptible of certain and speedy relief; in the other, or where the prescription is made to the symptom alone, all is confusion, uncertainty, and death. Or, it may be some organic affection of the heart, or gastritis, or enteritis, or little more than moderate degrees of indigestion, upon which the cough or dyspnœa depends and yet where, from want of a proper anatomical knowledge, or of physiological and pathological science, the most unhappy mistakes are made with the expectorants, but where the better informed are often greatly aided, in their embarrassments, by the stethescope.

But great as is the acquisition of the stethescope, the reign of morbid anatomy has surrounded it with many abuses; the vital signs are either neglected or held to be of very subordinate importance, and the instrument is turned in pursuit of structural lesions. If cough and dyspnœa supervene upon abdominal derangements, the source of the symptoms is not seldom found in some special lesion of the heart, or, others

detect in the supposed cardiac lesions the cause of an intermittent or irregular pulse that depends on hepatic disorder (§ 390 *b*, 688 *k*, 806, 811). These mistakes are a fruitful source of malpratice, and are common among the disciples of morbid anatomy (§ 697, 699 *c*, 701).

892⅘, *i*. The foregoing considerations appear to be indispensable to all who would enter understandingly upon the treatment of pulmonary affections, or to distinguish what is relative to the lungs from what is due to other organs, or to comprehend the modus operandi of the remedial agents, whether they be employed under the denomination of antiphlogistics, vesicants, pectorals, expectorants, &c., or their philosophical and comprehensive name of alteratives.

To the young practitioner, at least, I would say that it should never be forgotten that every inflammatory state of the mucous tissue of the lungs, however mild or chronic, is liable to become exasperated, and to give rise to pneumonia, or to croup, or what is extremely common, to phthisis pulmonalis. And when we again consider how often the last affection has been developed by the stimulating expectorants, I think that I do not err in my estimate of their relative uses and destructive effects in saying that mankind would be benefited by excluding from the treatment of pulmonary diseases all the reputed members of that group of remedies excepting those which belong to the first of the foregoing subdivision (§ 892⅘, *c*). Independently of the direct practical results, attention would be turned upon bloodletting, antimonials, &c., and their strikingly salutary effects in numerous cases of common inflammation of the pulmonary mucous tissue, and in the early stages, especially, of those inflammatory states which lead to pulmonary phthisis, would revolutionize the whole system of morbid anatomy, and eradicate the pathology which has been founded upon it. The laws of the nervous system should banish the "*speciality*".

In the next edition of my Materia Medica (and I make the suggestion on account of its practical bearing), it is my intention to substitute for the term *Expectorants* another which shall refer to their modus operandi; probably, *Alteratives adapted to Pulmonic Inflammations*, and I will rank *bloodletting* as the first, in a general sense.* This will take in, also, tartarized antimony, and ipecacuanha, in emetic doses. Its advantages may be variously illustrated. Almost any condition, for example, of muco-pulmonic inflammation may be accompanied with a strong predisposition to inflammation of the pleura, or, they may occur together, or in the form of pleuro-pneumonia. Very many turn directly to the expectorants, and, if they find their attention arrested at once, under an equivalent denomination, by bloodletting, and tartarized antimony, and unfettered by the term expectorants, the appropriate remedies may have a good chance of raising inquiry, and their trial may awaken new views in pathology, and dissipate some of the prejudices against loss of blood. The practitioner will soon imbibe the conviction which experiment produced in the distinguished Cleghorn, that bloodletting can scarcely be misapplied under any conditions of pneumonia, and be led to avoid the stimulating expectorants, as he will all the tonics, when he approaches the treatment of most inflammatory affections (§ 1005, *h*). In proportion as the loss of blood is less likely to be useful where any form of pulmonic inflammation, to which this remedy may be adapted, shall refuse to yield to its power, so in a greater ratio will the non-stimulating ex-

* This improvement was made in the edition of 1848.

pectorants, and all other means, be likely to fail. How unavailing, therefore, must be those stimulating expectorants which are so often prescribed, even by those who confide in early bloodletting, at the advanced stages of pneumonia! The sole object in view is that of increasing or starting expectoration, without any reference to the morbific virtues of the supposed remedy. Let us, therefore, have the best remedy, however late, whatever the sex, whatever the constitution or the age; and that remedy, in the cases supposed, will be the loss of blood, as affording the best chance for life. Whenever acute forms of inflammation subside into a chronic state, neither the pathology nor the principles of treatment change, unless as it respects partial modifications. In a general sense, the direct antiphlogistic plan should be continued (§ 752, &c., 1007 *b*, *c*, *d*, 1008).

In the language of the celebrated Dr. Freind, "There are some, perhaps, who may think these various inquiries into disease may not be of much service to the healing art. However, they must allow me to affirm, that it is of very great importance to physic that we have an accurate knowledge both of the peculiar signs and of the nature of each distemper, and, also, of its seat; for these being found, we shall be much happier in our inquiries into the means of cure. Whoever, therefore, perfectly understands the nature of a pleurisy, or peripneumony, will easily perceive what immediate relief may be had from opening a vein; for, upon this point so depends the whole safety of the patients, that, if you should depart from this kind of medicine in vain will you seek for any other."

But, I would finally say of pneumonia, that however the disease may abate under the direct effect of loss of blood it not unfrequently happens that the symptoms recur with more or less violence. It is this which we are to anticipate and watch, and to repeat the remedy from time to time as returning symptoms may suggest, and before the disease can have recovered its original severity (§ 1005, *h*). In this manner, we shall constantly make advances upon it, and, with the aid of other remedies judiciously devised, we shall not often fail of success. These, however, are cases in which firmness, and a constant recourse to pathological considerations, are more or less in requisition. Sanguine hopes may be called up by the great relief which is yielded by the first outlet of blood, but, to be only in a few hours disappointed by the formidable signs of returning inflammation; and when, at last, we shall have met them again and again by our principal remedy, the disease may appear to have come to a stand, and scarce falters under the combined effect of general bloodletting, leeching, antimonials, &c. This is no time for discouragement, but rather to fear that our means, in coming short of the mark, have not been applied in sufficient vigor. Now is the time, I say, to push the high principles of our noble science, to throw off the trammels of prejudice, and let the blood flow, till, by the relief it brings, we win new trophies for ourselves, and for medicine (§ 1005 *a*, *b*, *c*, *d*, *e*, *f*, *g*, *h*, 1007 *b*, *c*, *d*, 1008, 1068 *c*).—*See* P.S., 1860, at p. 872. Also, NOTE F p. 1114.

COUNTER-IRRITANTS.

893, *a*. I enter now upon the consideration of those remedial agents which establish their influences upon internal organs through the medium of the skin; and here is opened to us a display of those sympa

thetic processes which take their origin in cerebro-spinal nerves along with the sensitive fibres of the sympathetic, and terminate in the motor fibres of the ganglionic system (§ 113, 224, 454 *a*, 461–461½, 465, 473 *c*, 478, 488½, 489, 512, 514 *f*-*k*, 516 *d*, nos. 12, 13, 520, 891½ *g*, *k*).

That vesicants and leeches operate in the foregoing manner was expressed by me in the London *Medico-Chirurgical Review* in 1834. See p. 827, § 1056.—Also, RIGHTS OF AUTHORS, p. 914.

Counter-Irritants exert their effects upon parts remote from the seat of their application in the same manner as when cold applied to the surface excites the renal function, or lights up pneumonia, and through the very complex mechanism set forth at the beginning of this section, and in other places. Here, too, in the case of counter-irritants, we meet with an embarrassing diversity of central parts which govern the reflex nervous actions, and perplexing results as the irritant may operate through one centre or another—sometimes taking the route of the brain and spinal cord, and then proving morbific, or at other times operating through the ganglia or plexuses of the sympathetic nerve, or some portion of the nerve itself, in the vicinity of the counter-irritant, and then only proving curative (§ 233¾, 455 *a*, 456 *a*, 461½ *a*, 473 *c*, 478 *b*, 483 *c*, 889 *g*). We shall see, too, in all these influences the clearest demonstration that the nervous power is modified in its nature by the impression transmitted by the agent to the nervous centres (§ 481, 891½ *g*, *k*), and that it operates either as a directly morbific cause or is curative of existing disease by substituting pathological conditions more favorable to the recuperative tendency of the organic properties (§ 854, 900, &c.). Exactly the same philosophy, therefore, is applicable to the *modus operandi* of counter-irritants that I have hitherto represented as characterizing all other agents. But such is the diversity in the details relative to the laws and phenomena of the nervous system, whether resulting from its *direct* or *reflex* action, whether excited by the will, by mental emotions, or by direct physical irritations of the nervous centres in the former case (§ 227–230, 245, 481), or by transmitted influences to those centres from remote parts in the latter case, or as certain cerebro-spinal nerves are limited to a subservience of voluntary motion and sensation, or as others co-operate with the sympathetic by contributing to the essential office of the latter in harmonizing the organic functions, variously affecting the organic products in vital constitution, and perpetually exciting or depressing the secretory and excretory processes, and seeing how the latter mechanism is the great medium, through its physiological characteristics, of the transmission of the disturbing effects of morbific causes, and the restorative of such as are remedial (§ 113, 500 *g*, and *references above*), and, withal, the isolation of intermediate nerves when the mind or physical causes operate upon individual parts, and yet all determined by precise, however complex, laws, we find ourselves in a labyrinth where no light is admitted from the surrounding effulgence of inorganic nature, and recognize the impracticability of expounding its problems in any other than a language as foreign from chemistry and physics as are the functions and laws and phenomena of living beings, and the necessity of a copious analysis of all its parts (§ 5½ *b*, 59, 64, 165–169).* And this leads me to recur to what I have said of the terms *motor*, *sensitive*, and *reflex action* in § 475, that I may now add that *reflex action* should be regarded as expressing simply a general result without implying in

* See NOTES AA p. 1131, DD p. 1132.

the least the philosophy of the process. It may be made to stand for any hypotheses expressive of reaction, though least of all for that of galvanism, or any other emanating from the science of chemistry. The reflection even of polarized light, with all its modifications, would not serve as an analogical basis for the reflection of any influences transmitted to the nervous centres or of the nervous power, and all analogy disappears in those influences which take their rise in the centres themselves, or such as I have designated as *direct* developments of the nervous influence, and which, from the absence of *centripetal* impressions, and from engaging only the centrifugal nerves, discloses the defective import of the term *reflex action*. Nor will I neglect this opportunity of adding to § 409 *k* the important fact that the hypothesis of galvanism, as applied to reflex action of the nervous system, violates the indispensable requisite of a continuous circle, and contents itself with the most irregular segments, and these segments and curved lines consisting of two parts differently endowed, and manifesting peculiarities of function that bear no analogy to galvanism. Nay more; for in a still more discreditable manner it professes to be the agent concerned when the nervous influence, as in mechanical irritation of the nervous centres, engages only the centrifugal nerves, and then operates in a *straight line!* The experiments upon the frogs prove nothing beyond the fact, for here a continuous circuit is formed and galvanism developed. They are nothing more than the rudest experiments with inorganic matter.*

893 *b*. In my *Materia Medica and Therapeutics* I have arranged Counter-Irritants, with numerous other remedies, as an Order of Antiphlogistics, and under the general denomination of *Cutaneous and other Local Applications*. The counter-irritants consist of *Vesicants*, *Rubefacients*, *Suppurants*, *Escharotics*, *Potential Cauterants*, and *Actual Cauterants*.

893 *c*. Vesicants are by far the most important, though mostly confined to the blistering insects. The two next groups operate essentially after the manner of vesicants; but escharotics and cauterants are generally limited to simply local effects, and with only that obscure instrumentality of the nerves which must arise from their incorporation in compound tissues (§ 746 *c*), though often giving rise to local reflex actions, especially moxas, but too moderate for much effect upon internal parts. It is otherwise, however, with vesicants, rubefacients, and suppurants, which not only exert their useful effects through local nervous centres, but in unsuitable states (§ 893 *n*, *p*) the first two often send their influences to the cerebro-spinal axis, and thus develop a general reflex action that disturbs especially the motions of the heart and arteries, which are far more readily affected by these causes than the functions of any other organ (§ 113–117, 224, 226–233$\frac{3}{4}$, 339, 409 *k*, 446 *a*, 454–461$\frac{1}{2}$, 478, 480–485, 489, 490, 500 *dd*, *k*, *m*, 512, 516 *d*, no. 3, 524 *d*, no. 7, 526 *a*, *b*, 687$\frac{1}{2}$–688, 714–719, 746 *c*, 826 *cc*, 829, 846, 891$\frac{1}{2}$ *g*, *k*, 892 *b*, 892$\frac{1}{2}$ *v*, 893$\frac{1}{2}$, 902, 904 *c*–905, 905$\frac{3}{4}$, 952, 961 *a*, 1059). Again, also, when vesicants lead to irritative inflammation, which is often the case with children, and in the sanguine and nervous temperaments, or in others where general irritability is morbidly increased, the nervous power may be brought into general operation, and we may witness the full display of reflex nervous actions in one almost universal commotion of the body (§ 150). This may also follow too extensive an application of a blister, or of rubefacients, though no excessive irritation be produced in the skin; just as a scald of limited extent may be

* See NOTE Y p. 1130, ERR p. 1150.

salutary, while another less intense, but spreading over a greater surface, will be often fatal. In all these cases, however, the effect is morbific, and they exemplify the very close analogy between the operation of morbific and remedial agents (§ 901). It is, indeed, the amount of the agent, whether physical or mental, and the existing state of the body, which makes all the difference between salutary and morbid results. The amount of a remedy, which had been curative in one case, may, in the same dose in another case nearly analogous, or if not exactly applied, lead to a fatal issue. In the case of vesicants, their action should be so circumscribed as to operate mostly through *local* nervous centres, or by *contiguous*, not by *remote* sympathy; and hence a use of these terms (§ 497, 638½). Bloodletting will secure this by lessening irritability and *general* reflex nervous action (§ 224, 1038).

In the preceding discussions upon the materia medica I have been extensively employed in seeking out the provisions which the Author of Nature has so bountifully, however intricately, ordained for the relief of those principal diseases of mankind, fever and inflammation. And yet we have often had occasion to see that many of the most valuable agents for these purposes are directly productive of inflammation when unskillfully applied. This is often exemplified by many of the cathartics; and the Peruvian bark, and its analogous tonic associates, will relatively cure or exasperate intermittent fever according to the exact conditions under which they are administered. We have seen, indeed, that even wine, brandy, &c., now and then become remedies for fever, and even for inflammation (§ 752, &c., 892 *g*, *p*). The apparent contradictions I have endeavored to reconcile, and to show that the occasional coincidence in the results of agents which are opposed to each other under ordinary circumstances is due to a common law which governs the operation of all causes upon organic life. The causes operate upon those properties in which life fundamentally consists, and thus give rise to healthy, or morbid, or curative effects, just as they happen to affect those properties (§ 137 *d*, 150, 151, 177, 189 *b*, 350½, 350¾, 569 *a*, 638, 852 *a*). In disease, as we have seen, their susceptibility is variously altered from the natural standard, and variously so in any given disease, as in fevers and inflammations; according to the numerous fundamental and transient circumstances already set forth. It may be, therefore, that, in a few cases of *common* inflammation bark or wine will place the diseased conditions in as favorable a state for the recuperative efforts of Nature, as bloodletting and cathartics will do it in most other instances; and when either produce this auspicious change they are antiphlogistics. It is upon this principle, therefore (or that of the general tendency of a vast range of therapeutical agents to establish salutary changes in febrile and inflammatory disease, when duly employed), that I have assembled the most useful part of the Materia Medica under the general denomination of Antiphlogistics.—See Note Ee p. 1133.

The foregoing remarks are preliminary to a farther exposition of the same principles which are concerned in the therapeutical operation of the group of agents upon which we have now entered, and which are curative by exciting inflammation, or analogous conditions; and the best of them are such as will effect, in a given time, the nearest approach to a full development in the skin of the most simple form of *common* inflammation (§ 721, 722, 729 *a*). These means are, prin-

cipally, cantharides, issues, and setons. Their immediate action is strictly morbific; and they have no salutary effect upon existing inflammations till they produce a corresponding disease, or, at least, that morbid irritation which forms the access of inflammation, in some part of the surface of the body. Then it is that this artificial inflammation or irritation so modifies the natural one, that the latter may subside, rapidly, without any other curative influence; while the artificial one is so peculiarly constituted by the nature of the remote cause, that that, too, readily takes on a disposition to subside, and thus the patient escapes from the inflictions both of Nature and of art (§ 133 *c*, 137 *e*, 150, 151, 639 *a*, 852, 853, 854 *c*, *d*, *e*, 858, 905 *a*).

893, *d*. It has appeared to me a matter of no little importance to consider the foregoing facts and the philosophy which concerns them; since, in connection with what has hitherto been said of the operation of internal agents, and connected with what is yet in prospect relative to the special influences of loss of blood, they open widely a view of the great principles of solidism and vitalism, and of the stupendous laws by which healthy and morbid processes are carried on, and illustrate that connecting medium between them which is constituted by the various gradations of the restorative movements as instituted by remedial agents under the great recuperative law of organic beings. The whole is but an intimate chain of analogies from the most perfectly healthy state to the gravest conditions of disease (§ 901).

We see, also, distinctly exemplified by the mode in which blisters, setons, &c., produce their favorable results, that absolute remedies institute the process of cure in virtue of their morbific qualities; and this becomes the more striking when we associate with the alterative influences of vesicants upon internal inflammations, through the artificial disease which is established in the skin, those natural cutaneous inflammations, as erysipelas, &c., that are subdued by the direct contact of the vesicant with the inflamed surface (§ 893 *l*, 1059).

893, *e*. We may now pause, for a moment, to observe how clearly the various effects of cantharides prove the operation of curative agents, either by a direct action upon the organic properties of a diseased part to which they may be applied, or through the instrumentality of the nervous power when they extend their therapeutical sway to distant organs, and how, also, the nervous power is variously modified, and variously reflected upon remote parts, according to the nature of its exciting causes (§ 227, 228, 230, 233¾, 497, 500). The common mode in which cantharides, setons, moxa, scalding water, burns, &c., relieve or increase deep-seated inflammations, or disturb the system at large, is clearly manifest; and since only one of the foregoing agents is liable to absorption, every precept in philosophy divests the coincident effects of cantharides of a shadow of possibility that they are due to an absorption of the agent. We have seen, too, how erysipelas may be removed by the direct action of cantharides upon the part inflamed; and this (especially when associated with the remote effects of all other remedial agents) assures us, as a next link in the demonstration, that a modification is imparted to the nervous power, according to the special virtue of the remote cause, which operates, in that particular instance, upon the remote part in a mode corresponding more or less with that which is observed in the primary action. And now if we look at what is often going forward in the blad-

der, we shall see yet farther (something for the senses, something for "experimental philosophy") that the nervous power actually acquires the virtue of an inflammatory agent, and analogous, too, to the specific characteristic of that virtue as it appertains to cantharides. Now carry this to those inflammations which are constantly springing up in different parts as consequences of each other, in the natural round of disease, and you will come with me to the conclusion that the same philosophy obtains throughout. It is exclusive of absorption in the case of the bladder, besides other obvious objections.

It appears, therefore, that when erysipelas yields to the direct action of vesicants it is by the substitution of the *kind* of inflammation which cantharides produces in the sound skin, and which subsides spontaneously and speedily. Again, other local applications, as nitrate of silver, iodine, mercurial ointments, &c., will effect the same result by introducing other and very different pathological changes, or the erysipelatous inflammation may be subdued by loss of blood, or by cathartics, or by the constitutional action of mercury, or perhaps by stimulants. It is manifest, therefore, from all this variety of means, leading to a common result, that the cure depends in all the cases upon the substitution of some artificial pathological condition which is capable of spontaneous subsidence, though the changes which are thus forcibly introduced are as various as the remedies (§ 854, 892 *b*, *c*, 897–902, 904 *d*, 905, 1059).

But, though the cantharides supply an apt illustration of the whole philosophy of our subject, and, like the natural developments of in flammation which follow each other by reflected nervous actions, de note a modification of the nervous power in great conformity with the nature of the causes by which it is brought into operation, there is, nevertheless, a great variety of remedial agents, which, in their therapeutical doses, manifest no action upon the organ to which they are applied, and through which they overcome disease in parts remotely situated; as also other important ones, like mercury, when applied to the skin. And, although it be rendered obvious by the morbific effects of these agents that they modify the nervous power in their therapeutical aspects as much according to the nature of the several agents, respectively, as do cantharides, issues, setons, or as when one natural inflammation supervenes upon another, I have made the qualification which is due to a subject hitherto so entirely unexplained, that the modifications of the nervous power take place *under the influence of its own nature* (§ 228, *a*, 892½ *c*, 896–901, 1059, 1088 *b*, *c*).

Finally, in respect to the modus operandi of cantharides, when considered in its analogies to other vesicants, issues, &c., we have an interesting view of the specific relations which the special virtues of certain remedial agents sustain toward the modified irritability of particular parts of the organism, and a proof, also, of the diversified conditions of irritability in different parts, and of the remarkable manner in which the nervous power is reflected with salutary or morbific effect through certain motor nerves by the peculiarities of each exciting and modifying cause (§ 233¾, 500 *g*), while there is simultaneously presented by the operation of cantharides a curative influence upon all parts that are affected by disease, and a morbific one upon a special part that was antecedently in its natural state (§ 150, 151, 188 *a*, 190 *a*); but its action is useful only through local nervous centres.

893, *f*. From what has been now said, it is manifest that vesicants,

issues, setons, and other counter-irritants do not produce their favorable effects through the discharges to which they give rise; though this is one of the principal interpretations in the humoral pathology. The effusion instituted by cantharides is so unimportant that it can scarcely be taken into the account in explaining the curative influences of this agent (§ 863). Moreover, it frequently happens that blisters afford all the relief of which they are capable by acting merely as rubefacients. This, indeed, is oftener true than is commonly supposed, since vesicants are generally permitted to remain till vesication is established; though in numerous cases this extent of their action is unnecessary (§ 497, 1038).

Since, therefore, cantharides will often answer its intention when employed only as a rubefacient, and operates at all times through the vital impressions it exerts upon the skin, it may appear unimportant to some whether this or another agent be employed for the purpose of counter-irritation. Such, indeed, is, unfortunately, supposed to be true by many practitioners, who resort to mustard cataplasms, or ammonia, &c., where cantharides would be a far more useful agent. So true is this where active inflammation affects any of the important viscera, and vesication has become appropriate, and may be of the highest importance, the rubefacients, which operate speedily, have little or no salutary effect, and are often detrimental by increasing constitutional irritation (§ 150, 151).

893, *g*. The foregoing remarkable difference in results (*f*) is owing, in part, to the difference in the virtues of the remedies, and, in part, to the difference in time occupied by the several agents respectively. In all cases of very rapid irritation of the surface, vesication, &c., whether induced by ammoniated lotions, mustard, boiling water, moxa, &c., the curative effect upon deep-seated inflammations is far less than where the artificial disease is more slowly instituted. It is, nevertheless, of no little moment, in the case of vesicants applied for active forms of disease, that the irritation of the skin should advance with considerable rapidity, and that vesication should ensue, at adult age, in from six to twelve hours. That is the most useful period; and when the full action of cantharides is longer delayed, whether by some defect in the remedy, or by a subdued irritability of the skin, the curative effect is commonly less obvious.—*See* p. 298, § 476½ *h*.

It is also proper to observe, in a philosophical as well as practical sense, that time has various influences, according to the modification of disease, its seat, its duration, the constitution, sex, age of the subject, &c. It relates to the nervous power, and is explained in § 479.

But, in no respect is the influence of time so remarkable as seen in the difference of results in the treatment of acute and chronic diseases; in which respect counter-irritation is on a par with other remedial influences. When inflammation is recent, the usual rapidity with which cantharides operates is best suited to almost all forms of the disease; but when it has run into a chronic state, and has become the subject of habit, it frequently happens that tardy suppurants, such as setons, issues, tartar emetic ointment, &c., are highly useful (§ 535, &c.). Yet there is no doubt that the difference in results as it respects the time of these cutaneous agents, in the acute and chronic forms of inflammation, has been often much overrated; especially the advantage of a suppurating surface in chronic diseases. It is apt to be supposed, in

these cases, that there is something to be discharged, either "concocted matter," or such as refuses to be concocted.

893, *h*. Although it be true that chronic inflammations oppose to counter-irritants the obstinacy of morbid habit, and naturally suggest the long-continued and uninterrupted influence of issues, &c., experience has fully shown, that, in most cases of low indolent inflammations they are surpassed by a frequent succession of blisters. This experience, too, has mostly banished from use the savine ointment, and other agents, which were but lately and largely employed to maintain the action instituted by cantharides. The difference goes, with an endless variety of analogous facts, in illustrating some of the profound problems of organic life. The uninterrupted action of issues, the prolonged ulceration of vesicated surfaces, &c., are more or less apt to establish a morbid habit peculiar to the modifying agents; and, although it be a first step in the series of changes which are necessary to establish the full recuperative process, the pace is retarded by the habit induced. To break this force of habit, it is only necessary to intermit the agent during the time required by the healing of a blister. The curative impression remains, and the irritability of the organ diseased undergoes an increased susceptibility to the agent at its successive renewals. Each repetition gains upon the last, and often presents the aspect of cumulative influence. The principle is shown in relation to many things, and may be seen in the action of antimony, opium, &c., in former sections (§ 550–556, 558 *b*, 889 *m*, 902 *i*).

The influence of habit of which I have now spoken, as it respects the artificial change induced in chronic inflammations by the uninterrupted operation of issues, &c., grows out of the analogous habit which the agent establishes in the artificial or curative disease, which soon lapses into that chronic state which is less and less sensibly felt by parts morbidly affected; while those parts, and the entire system, are gradually accommodating themselves to the artificial irritation, and by which this irritation loses still farther its sympathetic and curative influences upon the morbid conditions for which it is instituted. But if, on the contrary, a succession of irritations be employed, the habit of which I have spoken is neither established in respect to the system, nor the parts diseased, nor in respect to the artificial condition; but every successive repetition of the irritation produces nearly as profound an impression as the first (§ 150, 151). Here, too, along with the coincident effects of numerous internal agents, we may call up the advantages of repeated leeching, as presented in a subsequent section (§ 926), and in which reflex nervous action is equally concerned.

The same great principles are involved in all the cases. An elegant philosophy obtains throughout; and, although founded upon the great Institutions of Organic Nature, it is surrounded by so many of the qualifying circumstances that are incident to the instability of the vital properties, it can be fully appreciated and converted to the high practical purposes of which it is susceptible only by a careful, impartial, and unremitting attention to the phenomena of organic beings.

893, *i*. The principles to which I have just adverted (§ 893, *h*) lie at the foundation of other practical facts connected with the success of counter-irritation. The impression upon the skin, for instance, must be carried to a certain intensity, and that will depend upon the nature and force of disease, and other obvious contingencies. If it be

slight, the necessary impression may not have been made; while, on the other hand, if in excess, then it may not only disturb the general functions of the body, but aggravate the inflammation which it is the design of the remedy to relieve. In this respect, therefore, there is a close analogy with the action of remedies, when administered internally, as it respects their doses.

Another important point to be observed is the extent of the surface over which an artificial irritation should be established. This will manifestly depend upon a variety of circumstances; upon the nature of the irritant, upon the extent, force, and situation of the disease, &c. If the usual agent, cantharides, be employed, and the surface irritated be of narrow limits, it may be insufficient to break in upon the morbid process, however intense may be the artificial irritation. On the other hand, however, if a very large surface be irritated, its reflex nervous action may be morbific, although the artificial irritation be not intense. The difference in effects is of the same nature as that which attends the small, deep burn of moxa and an extensive superficial scald; the former being of no importance, while the latter may be speedily fatal through a sudden and violent reflex nervous action.

But, there is a great difference between the effects of an extensive surface vesicated by cantharides, and by scalding water; and this probably arises mostly from the difference in the times which the remedies occupy. In the former case, the system is gradually accustomed to the reflex nervous actions, and may be but little disturbed, while, in the latter, the violence of the impression upon the system is proportioned to its instantaneousness; and the extent of the surface irritated being great, a violent shock ensues. In one case the remedy operates through local centres of the sympathetic nerve (§ 497, 893, *a*, *c*), in the other the cerebro-spinal axis is involved, and a general, sudden, prostrating nervous influence is developed (§ 476½ *h*, 479, 509, 893, *c*, *p*).

It is evident, therefore, that there is only a certain parallel between the effects of vesication by cantharides and scalding water, whether upon a small or an extensive surface,—scarcely exceeding the partial coincidence by which I have endeavored to illustrate the difference between small and large vesications by cantharides, and to expound again the principles concerned in the effects of agents which operate gradually or with great rapidity. The difference, indeed, is so great between the effects of vesication when the gradual result of cantharides, and those which are instantly induced by scalding water, that we may safely vesicate an extent of surface by the former agent which it might be fatal to attempt by the latter (§ 891, *m*). The tincture of cantharides, when applied to the skin, produces vesication with great rapidity, is far less curative, and oftener disturbs the constitution, than when vesication over the same extent of surface is produced by the common plaster.—See Experiments § 476½ *h*, 479.

Nevertheless, there are certain inflammations, especially of a neuralgic and rheumatic character, and not affecting important organs, in which a rapid and violent irritation of a very small surface, as by moxa, will sometimes overcome the disease. But these intense, sudden, and limited irritations, in affections of any of the important viscera, are never useful (§ 479).

If the disease be of a different character from inflammation, as the suddenly painful affections of the stomach that are incident to indiges-

tion, or, as in colic, &c., the rapid irritation which is produced by the rubefacients may then afford immediate relief, and more effectually than might be yielded by the vesicating action of cantharides. These rubefacients are, also, often abundantly efficacious in the declining stages of articular rheumatism, or in low chronic states of that disease. But this is a peculiar modification of inflammation which will also yield, under the same circumstances, to some internal remedies which exert no salutary influence upon the common, or other modifications of inflammation (§ 661, 662, 756 *a*, *b*, 892 *b*, 892½ *v*,904 *d*, 1059).

893, *k*. The vesicating plaster is generally made too small to yield all the benefit of which it is capable. Four inches square is a common size for the thorax and abdomen; while six or eight inches square are not only equally safe, but far more efficient, under the ordinary circumstances which justify or require this remedy. Indeed, so comparatively safe is it to institute an extensive irritation by means of cantharides, when the state of the system is properly prepared, and the force of disease is otherwise moderated, and so important is it in certain conditions of disease to effect a very powerful impression, especially in the cerebral inflammations that refuse to yield to copious abstractions of blood, that I have sometimes rescued patients by the apparently desperate practice of vesicating simultaneously the entire scalp and a large extent of surface upon the neck and shoulders. Where bloodletting has been thoroughly practiced, and inflammation remains obstinately seated in some great vital organ, a blister of twelve inches square may be necessary to determine a sufficiently powerful nervous influence, of which six inches would fail (§ 479).

But, in respect to inflammation of the brain, it should be distinctly understood that vesication of the scalp is entirely inadmissible, unless the irritability, and therefore the susceptibility, arising from the morbid state, be greatly lessened by abstractions of blood, cathartics, &c. The irritation of the scalp will be otherwise propagated with morbific effect upon the brain; which arises, in this instance, partly through continuous sympathy along the communicating vessels (§ 498). Nor is it expedient to incur the risk when immediate danger is not impending, but to apply the agent to the neck and shoulders. The same objection lies against the application of blisters to the immediate vicinity of the eyes and ligaments in their very irritable states of inflammation. But if, in these cases, the disease have lost its activity, or be of a chronic nature, the vesicant is then most efficient when applied near to the part affected. It sometimes happens, however, in chronic conditions, that the skin in the immediate vicinity becomes sympathetically affected through the same influences from the parts beneath as are propagated upon them, at other times, by vesicating the overlaying skin. These morbid states of the adjacent surface are generally obscurely marked; though sometimes abundantly apparent, as in active forms of articular rheumatism. The obscure conditions often become strongly pronounced by an irritative, erysipelatous inflammation which is set up by vesicants, and by leech-bites, and which commonly aggravate for the existing time the natural disease; though the morbific influence is apt to disappear, and leave the disease as it was, as soon as the artificial irritations subside.

893, *l*. It may be now said, as a general rule, that the liability of counter-irritants, when applied near to a part inflamed, to increase the

inflammation, is in proportion to the intensity of the disease, the intensity of the artificial irritation, and the rapidity with which it is produced. It may, therefore, be regarded as safe, in a general sense, to apply vesicants and rubefacients immediately over the affected parts in chronic inflammations. But this is far from being true of moxa, where the affected part is in the vicinity of the surface.

And yet we have seen that it may be sometimes perfectly safe and useful to place an epispastic in direct contact with certain inflammatory states of the surface. This, however, is never true of common inflammation of the skin, and only so of a few specific varieties. Their successful treatment in this manner, as in the case of erysipelas, opens to us another illustration of the principles upon which remedial agents operate. The disease, being a specific modification of inflammation, has not the disposition to subside spontaneously which belongs to common inflammation. The remedial agent, therefore, varies the mode of inflammation, and thus introduces a modification in which the properties of life are brought into recuperative action. But, it is otherwise with common inflammation, since the virtues of cantharides are such as to aggravate this condition when brought into immediate contact with the part affected. The same explanation applies to the thera peutical effect of the spirits of turpentine when applied to a burn or a scalded surface; since, in these cases, the inflammatory state is turned from the common standard, and admits of the institution, by other irritants, of modifications more favorable to the recuperative process. And so of nitrate of silver (§ 893 *d*, 1059).

893, *m*. With the qualifications now made, it is obvious from what has been said of the modus operandi of counter-irritants, that they will be curative in proportion as they are applied to the vicinity of the seat of disease. Their salutary effects, like their morbific, depend more upon this approximation than upon any special sympathetic relations between certain parts of the surface and the particular internal organs; since it is mostly through local centres of reflex nervous action that these agents produce their curative effects (§ 497, 893 *a*, *c*, 905 *a*).

It is also a remarkable fact, that it appears to be of no great moment in what particular tissue of compound organs the disease is seated. Inflammations of either are alike affected by irritants as they are by loss of blood; but varying, in all the cases, according to the general vital constitution of the several parts (§ 150, 151).

893, *n*. We have seen that it is the tendency of inflammation to limit itself to the tissue which it invades, and that its extension to other tissues of the same organ, or to other parts, is by remote or by contiguous sympathy (§ 497, 498). It is also particularly true of certain tissues that they are apt to extend the violence of their remote influences upon parts of similar organization; especially in specific forms of inflammation. Thus, rheumatic inflammation of the ligaments is very apt to invade the pericardium, and sometimes the dura mater; and, the peculiar inflammation which constitutes the mumps (cynanche parotidea) often involves the testes or the mammæ. There is much reason to think, in the former case, where the heart so often participates, that the inflammation is first propagated to the pericardium, and subsequently from that organ to the serous tissue of the heart (§ 141, 525–529). In the latter case, or that of the mumps, the affection of the parotid will frequently subside when the other glands become af-

fected; and the disease is then said to have undergone a metastasis, —a magnificent display of our alterative reflex nervous action. Articular rheumatism affords constant examples of this phenomenon, in its rapid and successive invasions of different joints, and the frequency with which it subsides in one as it springs up in another (§ 524 *a*, 3).

Now, there is a prevailing error in the pathological construction of this extension and subsidence of the disease, which has led to a very common error in practice. It is supposed that there is a translation of the disease from one part to another, an actual movement of the complaint —something, probably, after the manner of the gases, as represented in a former section (§ 350½, *n*). The phenomenon, in consequence, has long borne the significant name of *metastasis;* and if gout happen to go from the foot to the stomach, it wanders so much out of its way that it gets in the stomach the well-known and expressive name of *misplaced gout.* As all men, therefore, are greatly moved in their practical habits by theoretical views (§ 4), it is no less common to imagine that the rheumatic or gouty affection may be driven or invited back to its appropriate place. Hence the applications which are made to the primary seat of the affection, but from which disease has taken its departure. And so, also, counter-irritants are applied to the parotid gland, should the testes, or mammæ, become affected in mumps, in the expectation of calling back the disease which is so far astray.

In the first place, however, there is, in all these cases, nothing concerned but reflex actions of the nervous system, and nothing is wanted to render the treatment appropriate and intelligible but a knowledge of physiology and pathology. All the ambiguous results are directly referable to the laws which govern the operation of the nervous power, which now presents itself in the compound aspect of a morbific and remedial agent among parts which have either strong natural relations, or which are especially susceptible of morbific influences that result in the condition which is the supposed subject of translation from one part to another; while, in its turn, the sympathetic disease propagates, after the manner of vesicants, curative impressions upon the primary seat of the disease by like reflex nervous actions.

Secondly, the artificial irritation excited with a view to recalling the disease (as in vesicating the joints when gout attacks the stomach, and this, too, even when that organ may be the primary and only seat of the affection) is very different from the modification of inflammation which constitutes the pathological state of the disease itself, and therefore would not become, by any reflected influence upon the parts beneath, a substitute for it; while it is certainly an anti-pathological mode of recalling the specific, or any form of inflammatory disease, in deep-seated parts, since counter-irritation is one of the principal means by which we remove inflammation of these parts.

The foregoing practice, as founded upon the doctrines of metastasis and revulsion, is contra-indicated not only by physiological laws, but by all experience. The practice has been wholly directed by hypothesis, and has not been sustained by any favorable results. We need go no farther in proof of this than the admitted failure of M. Louis, in his application of "blisters to the legs," to remove, upon the foregoing hypothesis, the gravest forms of inflammation and disorganization of the brain, intestine, liver, &c., which befell the victims of "The Typhoid Affection" at La Charité. And here we see again exemplified

in the extensive sway which may be exercised not only by the authority of a favorite writer, but in the pernicious tendency of conclusions in medicine that are founded upon the results of practice as directed by errors in principles, the proneness of man to rest his inquiries, his hopes, his reputation, the happiness and the lives of mankind, upon simple views of the most abstruse, stupendous, and comprehensive Institutions in Nature,—the Institutions of organic life (§ 4, $5\frac{1}{4}$, $5\frac{1}{2}$, 349 *d*, $350\frac{1}{4}$–$350\frac{3}{4}$). But, let us have an example in relation to the effects of counter-irritation by cantharides, as propounded by the great head of the Necroscopic School. Thus:

"*Blisters*," says M. Louis, "*ought to be banished* from the treatment of the typhoid affection." "If they exercised any influence upon the duration of the disease in the patients who have recovered, it was by *prolonging* it a little."

Again. "I have not only *rejected vesication* from the treatment of *pneumonitis;* I have also ceased to employ it in *pleurisy* and *pericarditis*." "How can we believe that the effect of a blister is to check an inflammation, when this blister is one inflammation superadded to another?"! "In thoracic inflammations, their usefulness is neither strictly demonstrated (according to the *numerical method*), *nor even* probable."

"One thing is *most assuredly beyond question*, and we should never be weary of repeating it: that the *therapeutic value of blisters is not known;* that it must be studied by the aid of *numerous* and carefully-noted facts, *just as if nothing at all were known about it*."

If the reader be not conversant with the history of that kind of "experimental philosophy" upon which the foregoing conclusions are founded, or with the efforts which are in progress to give it an ascendency over the philosophy which Nature teaches, he may obtain some knowledge of their extent by referring to foregoing sections (§ $5\frac{1}{2}$ *a*, 349 *d*, $350\frac{3}{4}$ *kk*. Also, *Med. and Physiolog. Comm., Essay on the Writings of M. Louis*, vol. ii.).

Instead, therefore, of the unavailing efforts of applying blisters to the extremities for the relief of cerebral, or hepatic, or intestinal, inflammation, &c., let them be directed to the organs which are the seats of disease, by applying them over, or in the vicinity of, their regions, to obtain the advantage of local centers of reflex nervous action (§ 224).

As to the doctrines of metastasis and revulsion, which have had their origin in the phenomena of reflex nervous actions (especially as witnessed in the successive development and subsidence of disease as they obtain in gout, rheumatism, and mumps), the whole system is constantly supplying examples of the accession of one disease as the sympathetic consequence of another, and the subsequent decline of the primary affection as a sympathetic result of the secondary development. And here, by-the-way, we are presented, in the natural process, with a perfect exemplification of the principle upon which counter-irritants operate in subduing diseases remote from the seat of their application; and we may thus readily comprehend how it happens that the discharge from an ulcer, or a seton, or blister, &c., will be suddenly arrested, or the superficial parts turned into the worst conditions, by the occurrence of disease in some internal part (§ 740).

The foregoing play of sympathies, however, is far from being equally true of all organs, or of all forms of disease. It is most distinct-

ly pronounced where pulmonary phthisis is preceded by gastric derangement, when the occurrence of the former often takes the lead and relieves, for awhile, the latter affection; but only again to light up indigestion, and ulcerative inflammation in the intestinal mucous tissue (§ 803, 804). But, it is rare, perhaps never, that remote diseases are favorably impressed by any form of disease that may happen in the alimentary canal. On the contrary, indeed, all such conditions are likely to aggravate or to maintain any affections that may be remotely situated, their reflex nervous actions being morbific.

Nevertheless, such is the analogy between the reflex nervous actions of diseased parts,—between the rise and decline of diseases, in certain parts, as consequences of each other, and the curative effects of many internal agents, that a vast number of therapeutists, overlooking the relations of the alimentary canal to all other parts, confound these internal remedies with the external counter-irritants; classing them all under the name of revulsives or counter-irritants. And here is opened another wide door to an excessive abuse of violent internal agents, and where we may well contrast the ten-grain alterative dose of tartarized antimony, and the most powerfully-irritating cathartics, administered with a view of establishing counter-irritation in the stomach and intestine, with that prejudice against bloodletting which sees nothing of the counter-irritant in the effects of this remedy. And how well does not all this submission to theory admonish us of the importance of investigating the nature of the influences which are effected by loss of blood (§ 4)! We all know what is doing in the way of tartar emetic. But let us take an example of the same philosophy from among the cathartics; for this is the only way of helping the cause of humanity in such cases, or of arresting another evil (§ 878) upon a more selfish principle. Let us go to the erudite and ablest work on Materia Medica for an example; and we will have others respecting certain substitutes for bloodletting in a future section (§ 960). Thus, then, Pereira:

"Pliny truly observes that the juice of the *elaterium* apple is dangerous when applied to the eye; and Dr. Clutterbuck mentions that some of it 'getting accidentally into the eye in one instance, it occasioned severe pain and inflammation, with an erysipelatous swelling of the eyelids, that continued the following day.' We have a farther proof of its irritant properties in the inflammation and ulceration of the fingers of those employed in its preparation. When swallowed, therefore, *elaterium* irritates the gastro-intestinal membrane, and occasions vomiting and violent purging." "In some dropsical cases, I have known a single dose discharge several pints of fluid from the bowels. The gripings, and the increased number of evacuations, prove that the irritation is not confined to the mucous coat, but is extended to the muscular coat. Under the influence of a full dose, the pulse is excited, the tongue becomes dry, and sometimes furred, and great thirst is produced. Considered with respect to other cathartics, we find it *pre-eminently* distinguished by the *violence* of its purgative effect."—Pereira's *Materia Medica*.—Notes H K pp. 1117, 1119.

And yet is this cathartic commended above all other *hydrogogues* for the cure of dropsy; and even boldly so, upon the principle of its producing *counter-irritation* in the gastro-intestinal mucous tissue; that is to say, the same sort of inflammation which affects the fingers

when the juice is applied to the skin. It should be also said of so valuable a work as that from which the foregoing extract is made,—valuable as a system of *Materia Medica*,—that Pereira approves the practice, and of course, therefore, the principle. The principle is thus stated by the author:

"Its effects," he says, "in dropsy, are two-fold; first, absorption of the effused fluid; secondly, the stoppage of any farther effusion in consequence of the *metastasis* of vital action from the seat of the dropsy to the intestinal membrane."

And again, he says, "In apoplectic affections, elaterium, as a drastic cathartic, sometimes proves serviceable on the principle of *counter-irritation*."—NOTE G p. 1116. Also, § 1065 *d*.

That is the doctrine. A metastasis of the inflammation to the intestinal canal; and such is the virtual effect. But I have shown that counter-irritants exert their good effects only through local centres of reflex nervous action, while they are injurious when they develop a general reflex action of any intensity through the brain and spinal cord, however those organs may otherwise participate; and such is the pernicious effect attending this counter-irritation of the intestinal canal.

Opposed to metastasis, revulsion, derivation, &c., is the doctrine of *repulsion*. Thus, in respect to the utility of vesicating the joints in acute forms of rheumatism and gout there is a strong array of opposite opinions. The objections to the practice are founded upon the same pathological conclusions that have led to the cultivation of ulcers, cutaneous eruptions, &c.; it being supposed that it is often the effect of counter-irritants to repel (as it is called) the disease from the joints, and to establish it upon the heart, the stomach, or other important organs. This supposed effect, therefore, is exactly the reverse of that which I have just considered, or the induction of disease to sound parts by counter-irritation. In one case, the advocates of metastasis suppose that they invite disease from one part to another not diseased; in the other they are employed in driving disease from the affected part to another part not affected.

That is the modus operandi. But, its fallacy is shown, at once, by the flitting character of gout and rheumatism; suddenly subsiding in particular joints and as suddenly invading others, or attacking the internal viscera, when counter-irritants are not employed. Indeed, it is now known that inflammation of the tissues about the heart is a very common attendant of articular rheumatism; and the fact that acute gout is, at present, rarely treated by vesication, yet as frequently as ever invades important organs, disproves the assumption as to the tendency of blisters to produce these results. But, I am not advocating the employment of counter-irritation in acute forms of rheumatism and gout; certainly not till the intensity of disease is greatly subdued by antiphlogistics of a sedative nature, and general reflex action reduced.

In connection with the last remark it is also worthy of observation, that free bloodletting in acute rheumatism is strongly opposed upon the ground of its tendency to involve the heart in rheumatic inflammation. But, in all the reputed cases the inflammation had probably already affected the heart before the abstraction of blood, and constituted cases for a very extensive application of the remedy. If loss of blood will surmount the disease more speedily in any other part than the united force of all other means, it cannot, surely, fail of a corresponding effect upon the main source of the circulation (§ 500 *m*).

893, *o*. Among the evil consequences of vesication is a bad condition of cutaneous inflammation, which either refuses to subside and annoys the patient by its excessive irritation, or it results in extensive ulceration, or in gangrene. These conditions are owing to a very morbid state of the skin, generally consequent on some formidable disease affecting the great viscera of the abdomen; especially the gastro-intestinal mucous tissue (§ 689, *l*). They add, of course, greatly to the evils of the disease, and hasten a fatal termination, which is apt to ensue upon the disease itself. These effects of blisters are most frequently witnessed in scarlatina, and often along with parotis, and ulcerated, or sphacelating, fauces. But, happily, they are rather rare; certainly less frequent than is surmised by many. It is never possible to know the existence of the peculiar condition of the skin which gives rise to these consequences; no more so than we are able to infer the predisposition to erysipelas which is often established by abdominal affections (§ 689, *l*). From their rarity, also, an apprehension of their possible occurrence should never deter us from the use of blisters.

Strangury is another, and a frequent evil of cantharides, though it does not often aggravate any existing disease. The urinary bladder has no strong physiological relations beyond its own system of organs, and pain is not apt to prove morbific, of itself (§ 140, 422, 891 *m*). There is no way of preventing its occurrence in particular subjects with any certainty.

893, *p*. The foregoing are the most obvious injuries which are produced by vesicants, especially by cantharides (§ 893, *o*). These unfavorable results, indeed, are commonly regarded as the principal ones to which the common epispastic is liable. But, there are others, which, though too often neglected, are far more important, since they are frequent, and often determine a fatal issue of disease. These evils arise from morbific influences which are propagated abroad either by too intense an irritation of the skin, or from creating the irritation under unfavorable circumstances (§ 893 *c*).

It is the last condition which is the most frequent cause of the unfavorable effects of blisters, and which, in the hands of superficial observers, have led to the denunciation of this important antiphlogistic.

The inauspicious states for vesication depend, especially, upon too exalted irritability of the parts diseased, or of other organs; particularly of the heart and general circulatory system. If blisters, or other counter-irritants, be applied to the skin in this state of morbid irritability, the diseased parts are roused to a greater intensity of morbid action, and the whole vascular system to a more violent movement; so that a series of untoward results is thus instituted, which sympathetically, and mutually, aggravate each other, and give rise to new morbid developments, till the multiplying reflex nervous actions may be arrested only by their own fatal tendency. Nor can I doubt that many of those terrible inflammations, and structural lesions of all organs, which abound in M. Louis' work on the *Typhoid Affection*, and which have been taken as the basis of the most important principles in pathology and therapeutics, were owing to the cause now under consideration; since this distinguished man was about as hostile to bloodletting as he became toward vesication, after witnessing the latter's effects in the complicated malady which will be long celebrated in the annals of medicine (§ 893 *a*, *c*).

The system, in the advanced stages of fever, is generally in an irritable state, is oppressed with local congestions and inflammations; or whether so or not, the artificial irritant becomes a source of annoyance, and often adds to the dangers it was intended to avert. This, indeed, is especially the time when such useless local irritations should be avoided, or quieted if they exist. Remaining inflammations and congestions should be treated with as little additional disturbance to the system at large as may be possible in those advanced stages of fever which were the subjects of Louis' experiments, and of too many others. Or, if it be necessary to resort to counter-irritants for their removal, they should be, at least, applied in the vicinity of the affected organs, where, alone, they can be of any avail.

Independently, therefore, of the direct and immense advantages of bloodletting, cathartics, antimonials, &c., we realize more sensibly the force of their importance, in acute inflammations, at least, when we consider that without the antecedent aid of one or another, but of bloodletting especially, we are completely cut off from the benefits of counter-irritation. Nay, more; so great are the prejudices against the principal remedy for inflammation and fever, or so sparing is its application, that cathartics inflict many evils when they might otherwise be rendered highly salutary, or their necessity, as well as of epispastics, superseded by moderating general reflex nervous action.

In all grave inflammations loss of blood is indispensable to the most useful effects of cathartics, or to their safety, and is absolutely the only condition under which counter-irritation should be attempted. Just as long, also, as the disease may remain in force, or general or local abstractions of blood may continue to be useful, vesication should be delayed. This remedy may then succeed with the most happy effect upon any remaining disease, even though it have passed into some other form than that of inflammation.

In the chronic states of inflammation, whether of important or unimportant parts, a frequent renewal of blisters may effectually surmount many obstinate maladies. But here, again, these agents are often powerless, though not as mischievous as in acute inflammation, till decisive bloodletting have been adopted, and, not unfrequently, often repeated. This is every day witnessed in those advanced stages of indigestion where a low chronic gastritis is shown by tenderness over the region of the stomach, and where, too, the liver has generally become more or less involved in morbid action. Vesication will not reach this condition till general bloodletting or leeching shall have been duly premised; and cases are not uncommon, where, after repeated and large abstractions of blood, such is the force of morbid habit that the disease finally issues in copious hæmatemesis. There are, also, many of the fluctuating states of the stomach in chronic indigestion, where no inflammation has invaded this organ, in which blisters over the epigastric region, and without any other remedial agent, bestow great relief. The appetite and digestion are at once improved, and the patient started along upon the road to health, and placed in a state for the full and rapid influence of change of air, exercise, &c. The analogy, too, in these cases, with the useful effects of tonics and stimulants in others, contributes farther light upon the therapeutical influences of the latter remedies (§ 890½). Again, among the sequelæ of fevers is constantly before us a variety of phases of indigestion in which vesi-

cation of the epigastric and hepatic regions brings great relief to the sufferer, when this remedy is properly sustained by a well-regulated diet, and other salubrious habits.

893, *q*. There are numerous remedies, besides those which have been under consideration, that operate more or less upon the principle of counter-irritation, and yet exert an alterative action peculiar to each. This is even true to a certain extent of leeching; the irritation of the bites, and even the new action which is instituted in the capillaries of the skin by the leeches, being analogous to the irritative process which is set up by the true counter-irritants (§ 498, 923).

But there are great modifications, in these respects, between the local influences of leeching, and the effects of the true counter-irritants, and, if we now turn our attention to the large group of agents under the denomination of *local alteratives*, as set forth in my Materia Medica, we shall see, that, in all the instances, each substance has an alterative action peculiar to itself; while, in many of the cases, as with iodine, the mercurial plaster, veratria, camphor, &c., there are associated influences analogous to those which form the great characteristic of the true counter-irritants. These, however, will of course depend upon the amount of absolute irritation which the several agents may produce in the skin; some, as gum ammoniac plaster, proving a very positive irritant, and affording relief to chronic inflammation of the joints more in virtue of this counter-irritation than of alterative properties peculiar to the agent (§ 227, 892 *b*, 900, 905 *a*, 1059).

That common principles, however modified in their general aspect, and however varied in the details relative to the several agents, respectively, are concerned in the principal results, is obvious from the fundamental simplicity of organic laws, and especially so from occasional coincidences in the curative effects of all the agents now under consideration. We see, for example, in cases of indolent tumors, chronic enlargements of the liver, spleen, &c., that almost any one of these local alteratives will sometimes yield complete relief. We see it following the application of either leeches, or blisters, or ammonia, or mercury, or iodine, or even of simple friction, &c.; and, if we next regard the corresponding effects of many internal remedies for the same conditions of disease, we shall not fail to detect a coincident and harmonious philosophy throughout (§ 892 *b*, 892½ *v*, 892⅔ *t*, 904 *c*).

In connection with the foregoing subject, it may be useful to some who may be baffled in their attempts upon indolent tumors of low inflammatory growth to know the advantages that have often accrued to myself from the frequent application of a small number of leeches. Where they may refuse to yield under this mode of treatment, vesicants, or iodine, &c., may ultimately prove efficient, when they might have been powerless without the antecedent influences of leeching. The tumors, indeed, may not apparently have yielded in the least to the virtues of the leech; but this remedy will have placed the diseased part in a state of susceptibility to the action of other agents. The principle has been variously before us (§ 556, *c*), and may receive another exemplification in the frequent necessity of general bloodletting and cathartics to the salutary effects of vesication, in the treatment of acute inflammation (§ 137 *d*, 150, 151, 556 *c*, 890½ *g*, 892½ *u*).

893, *r*. In all hemorrhages from important organs, we should regard vesication as a remedy next in importance to the general and local ab-

straction of blood, if the latter be also appropriate, as it commonly is in the early stage of the disease; and when, at more advanced periods, Nature takes on this recuperative effort, vesication is the principal remaining means by which we may contribute an aid that timely bloodletting would have greatly surpassed, and would have given to art what ultimately belongs to Nature (§ 805).—Notes F p. 1114, II p. 1139.

893½. Before entering upon the following Summary Review of the General Philosophy of the modus operandi of Remedial Agents, whose operation I have resolved, essentially, by alterative influences of reflex actions of the nervous system, and with a reference, also, to what I have said so extensively of this universal agency in the organic life of animals, I will recall an important ground by which the reader may be aided in his conclusions upon this subject, and which had escaped observation till the publication of the *Medical and Physiological Commentaries*. Even Dr. Philip, in his experiments (§ 476–493), neglected the analogy of which I am about to speak, referred the modified secretions to chemical agencies, and sacrificed his great labors to the interests of chemical physiology and the humoral doctrines. This analogy is the admitted operation of reflex nervous influences in exciting muscular movements. But that is the only result that is witnessed. There is no obvious change in the muscular action from what is natural. Not so, however, with the results in the great processes of organic life. Here the secretions are not only increased or diminished, but modified in their nature, and various morbid conditions produced or removed; and hence it is assumed that these results must be owing to very different causes from that nervous power which simply produces contractions in the muscles. It is entirely neglected, in this *rationale*, that the vascular systems are totally different in their functions from those muscular fibres upon which the nervous power makes its obvious demonstrations, as in convulsions, vomiting, respiration, contractions of the iris, of the sphincters, etc.; and, although there is a vague apprehension with some that blushing is owing to nervous influences, yet as there is seen only a transient redness, even this ground of analogical reasoning to changes of vascular action that give rise to increased, or diminished, or otherwise modified secretions, or the production or removal of disease, etc., is equally regarded as an abstract fact that supplies no information upon the less obvious problems. Neither is it considered that the vascular apparatus manifests a far more exquisite susceptibility to the direct action of common stimuli than the muscular fibre, and therefore that the vessels may be equally sensitive to that nervous influence which so readily excites the fibre in muscular organs. Another difficulty consists in comprehending the modifying influences of the nervous power upon secreted products, and in its production and removal of diseases, etc., according to the nature of the remote causes; and this grows out of the habit of neglecting the phenomena and of reasoning alone from what is physically demonstrable. It should be also considered that the cerebro-spinal system in subserving the structures of animal life exerts the effect only of a simple stimulus, while the ganglionic not only unceasingly modifies the natural organic functions and products, but, through this physiological constitution, to a far greater extent when morbific or remedial causes operate (§ 113, 224, 356 *a*, 422, 455, 461–461½, 475½, 487 *h*, 488½, 500 *g*, *m*, 524 *d*, no. 7, 526 *d*, 891½ *g*, *k*, 1059).—*See* Note Aa p. 1131.

SUMMARY REVIEW OF THE GENERAL PHILOSOPHY OF THE MODUS OPERANDI OF REMEDIAL AGENTS.

"It seems to me that the explanation which represents Nature always pursuing a uniform course in her operations, drawing the same results from the same principles, has a greater degree of probability than that which shows her separating, as it were, this phenomenon from all the others, in the way which she produces it."—BICHAT.

"Medicines differ from poisons, not in their nature, but in their dose."—LINNÆUS.

"NATURA MALUM SENTIENS GESTITAT MAGNOPERE MEDERI."—GALEN.

"NATURA REPUGNANTE, NIHIL PROFICIT MEDICINA."—CELSUS.

"NATURA DEFICIENTE, QUICQUAM OBTINET MEDICA ARS, PERIT ÆGER."—HIPPOCRATES.

894, *a*. THE philosophy which concerns the operation of morbific and remedial agents was a subject of consideration in the first two volumes of the *Medical and Physiological Commentaries*, and subsequently in an Essay which contributes to the third volume of that work. The question has also been investigated, extensively, in different parts of these Institutes. But, it is a part of the plan of the present work that its consummation shall consist of a distinct exposition of the important matter now before us, in the form of a summary review of the relative facts and doctrines contained in former sections.

894, *b*. In approaching, again, the *modus operandi of remedial agents*, I may first repeat the most essential points,—that the vital principle is a real substantive agent, of which the vital properties, irritability, mobility, &c., are elements, implanted in organic beings for the animation of their structure; that the nervous power was superadded also to the animal kingdom; that all organic functions are carried on, through their instruments of action, by the four vital properties which are common to all animated beings; that all vital agents, whether stimulant or sedative, whether natural, morbific, or remedial, operate directly upon these properties, as also the nervous power when concerned in developing motion or changes; that all disease consists in a modification of these properties and a consequent change of function, and is therefore only a variation of the natural states; that the vital property sensibility possesses a modification which I have denominated sympathetic sensibility; that the nervous power is a vital agent, and, like other agents, develops motion and induces changes by acting upon the organic property irritability, and is exclusively the exciting cause of motion in animal life; that this power or property of the vital principle in animals may be called, in a direct manner, into increased, or preternatural, operation by direct impressions, physical or mental, upon the nervous centres, or upon the trunks of nerves; that this power is the efficient agent of remote sympathy, is brought into operation by impressions made upon sympathetic sensibility, which are transmitted by this variety of sensibility, through sensitive nerves, to the nervous centres, and there develop the nervous power, which is reflected, through motor nerves, upon the irritability of such parts as may be determined by the various influences hitherto expounded, and thus become the exciting cause of motion, of morbific or therapeutical

changes, &c., in those parts upon which its impressions are made; that the nervous power is susceptible of modifications by the causes which bring it into universal operation, whether physical or mental, and thus partakes, *under the influence of its own nature*, of the special virtues of each exciting cause, to which principle is due its alterative effects according to the nature of the exciting causes; and, finally, that a common principle is at the foundation of the philosophy, whether the manifestations of the nervous power be displayed in subserving the natural processes, or in disturbing their normal condition and products, or in restoring disordered functions, or as the power may be concerned in developing motion, voluntary or involuntary, when propagated immediately from the nervous centres, and without, of course, the intervention of sensitive nerves, and therefore in a *direct* manner.

895. These several fundamental points have been critically presented in former sections (now too numerous for special reference), and they have all an immediate interest in the operation of remedies. They form the great principles which concern the natural operation of vital stimuli, and are, therefore, fundamental in the production and cure of disease. The plan of Nature is thus perfectly simple, consistent, and sublimely beautiful, in its foundation. The details are distinguished for their harmonious variety and intricacy, yet susceptible of the most complete analysis. We trace the complexities to the constitutional nature of the organic properties,—to their liability to multitudinous variations from their natural state,—to the various natural modifications which they sustain in different tissues and organs,—to the variety of those organs, and the differences in their respective functions,—to their intricate connections and dependences by means of sympathy,—and to the endless variety in the nature of the virtues of foreign agents which are capable of inducing modifications of the organic states of every part, and according to the nature of each agent.

Such are the great points to be kept in mind; but most of all, as it regards my present inquiry, are the various considerations relative to the nervous power, and its laws of reflex action, as hitherto set forth, and through which I interpret all the influences produced by morbific and remedial agents upon parts that are remote or but slightly distant from the direct seat of their operation, and often, in part, upon their direct seat of action, unless such influences are propagated by continuous sympathy (§ 2 *b*, 143, *c*, 148–151, 495–529, 855, 895, 902 *f*).*

896. The whole philosophy of the operation of morbific and remedial agents rests, as we have seen, upon physiological principles. Exactly the same philosophy relates, also, to the corresponding effects of mental causes. The wound, or the poison, or the errhine, which convulses the muscles, the want of air which determines respiration, the impression of light which guides the motion of the iris, the irritation of fæces or of urine which maintains a contraction of the sphincters, the food which excites the muscular action of the stomach or the contraction of the pylorus, the cathartic which purges, the emetic which vomits, the narcotic which arrests diarrhœa, or allays irritability, or induces sleep, the gastric stimulant or the remote inflammation which rouses the sanguiferous system, or the sedative which prostrates the circulation, or as one or another may destroy life, produce their effects through a common law which is relative to the nervous power, and it is through that same law that the complex organization

* Continuous sympathy is *continuous influence* of these Institutes (§ 129 *c*, *f*, 498 *a*).

moves on in harmony in all its parts, that the mind brings into action the voluntary muscles, that syncope is removed by pungent vapors, or by a current of air, or by a dash of water, that cold to the surface determines the first inspiration of the new-born being, that warmth to the skin instantly rouses all the processes of life in certain prostrating conditions of disease, that cold at the zero of Fahrenheit, or mechanical irritation, reanimates the torpid hibernating animal, and sends up his temperature from forty or less to near a hundred degrees, that the first contact of solid food with the stomach diffuses a warmth over the cold surface of the famished traveler, or that tonics and stimulants do the same, that shame or anger suffuses the countenance, or fear withdraws the blood from the circumference to the centre and bathes the skin in perspiration or renders the urine redundant and the bladder irritable, that cold, when suddenly applied, as suddenly increases the excretion of urine, or the hot bath determines, as suddenly, its expulsion, that offensive odors, offensive sights, and even their recollection, lead to instant vomiting, or to purging, or to syncope, that an hour's change from one part of the town to another suspends pertussis or promotes digestion or the healing of an ulcer, that one passion cures the most obstinate maladies, or another is instantly fatal,—each, and all, I say, determine their effects either through *reflex* or *direct* action of the nervous system. Anatomy and experiment confirm what each phenomenon, and all united, proclaim the work of that mystic power, operating on those organic properties which are the moving springs of every action, the proximate cause of every effect; nor can another intelligible solution be rendered for a single phenomenon now expressed, or thousands of similar import, while every other must be in conflict with the pronunciations of Nature and the demonstrations of art. Nor will an attempt be made (an attempt that shall commend itself to the understanding) now, or hereafter, to controvert the philosophy which is here presented. The first step in its overthrow must be the overthrow of Nature. All must bow to this conclusion, however unacceptable to the humoralist, or unpalatable to the materialist (§ 1034, 1039, 1040, 1075).

897. It has been seen, also, that the fundamental philosophy of disease is perfectly simple, as also that which concerns its cure; that disease is essentially nothing more than a deviation of the properties of life from their natural standard, and a consequent corresponding change in the functions over which they preside; that the artificial cure consists in a restoration of those properties and functions by making upon the former certain impressions which enable them to obey their natural tendency to a state of health; that remedial agents of positive virtues operate like the truly morbific, but less profoundly in their therapeutical doses, and that the philosophy of their cure consists in establishing, in a direct manner, certain morbid alterations in the already diseased properties and actions of life which are more conducive to the natural tendency that exists in the vital properties to return from morbid to their natural states.

898. It follows, therefore, when disease subsides under the influence of remedial agents, that it is only in consequence of the great law of recuperation, which is brought into sensible operation by the production of morbid states which are favorable to its development. But, if disease terminate fatally, it is owing either to morbid altera-

tions which transcend the recuperative tendency, or to physical obstacles which have resulted from the altered vital conditions. If disease subside without the intervention of art, it arises from the operation alone of that natural principle which has been established for the preservation of health, and the perpetuation of organic beings. Of this we have remarkable and striking examples in small-pox, measles, &c. For wise purposes, as we have seen, a principle of mutability has been established in the properties of life, and it is through this principle, which is designed for useful ends in the animal economy, that they are liable to be variously altered from their natural state by physical and mental causes; but it is this very principle which enables them to receive salutary impressions from remedial agents (just as morbific affect them), and to return to their natural condition.

899. The changes, therefore, to which the properties of life are liable, are almost of endless variety; depending, as we have variously seen, upon the nature of the operating causes, habits, natural and acquired temperaments, age, sex, &c.; and whenever they become diseased, they pass through a variety of progressive changes till they reach the acme of their morbid states. And so, on the other hand, when remedial agents begin their operation, a series of other changes sets in, and continues in regular progress until it ends in health. The pathological conditions, therefore, of any given disease are constantly varying, and may require frequent variations of treatment.

900. It being only necessary to introduce a peculiar morbid change in diseased conditions that shall favor the operation of the natural tendency of the properties and actions of life to return to their healthy state, a very few remedial agents may be all that are requisite to the attainment of that result; while experience shows that our materia medica is encumbered with superfluities. Take a large variety of pathological conditions, such, for example, as are presented by inflammation, it is not necessary that a certain uniform change should be established by the remedies, but only such as shall favor the recuperative tendency. Bloodletting brings about one kind of change, cathartics another, antimony another, mercury another, and so on; while each of these agents may prove perfectly curative in many cases of all the modifications to which inflammation is liable from absolute morbific agents. And yet it is obvious that each one produces changes peculiar to itself, while the changes induced by either will be as various as the natural modifications of disease (§ 756, *a*). And just so it is in respect to the great variety of remedies which will tend to the cure of intermittent fever. This disease will sometimes yield to almost every thing in the materia medica, and may be suddenly broken up by an emotion of the mind. But every agent exerts changes in the morbid properties of life peculiar to itself, but such changes as enable the properties and actions of life to pass, afterward, through a succession of spontaneous changes under the restorative principle, till they end in health.* There is no other philosophy that will account for any of these phenomena, while they all concur in demonstrating its foundation in nature. Hence, also, I may add, what I have already endeavored to expound, the occasional salutary effects of alcoholic stimulants in the treatment of fever, and acute inflammations, and through which, in part, I have attempted to abolish the distinction between active and passive inflammation. In these exam-

* See NOTES K p. 1119, L p. 1120, EE p. 1133

ples, the alcoholic stimulants do but introduce morbid conditions that are favorable to the recuperative process, and are, therefore, so far on a par with loss of blood (§ 756, 851, 854, 892 *b*, 892½ *v*, 1059).

901. Nevertheless, a distinction is very properly made into curative and morbific agents, however the former may be productive of disease, as they commonly are, in their medicinal doses when they do not correspond with the existing pathological conditions. Their absolute mode of action, however, is the same in all the cases; and although, in a general sense, remedial agents exert their salutary effects by inducing new pathological states, and are generally liable to produce disease when exhibited in health, these morbid states, when not excessive, are of a nature to allow the full exercise of the recuperative tendency. On the contrary, however, there is a class of agents which are more profoundly morbific, and whose results transcend the natural recuperative process. It is for the removal of these consequences that we employ the other class of morbific agents. Or, there are yet other means, like exercise, air, &c., whose influences are of the mildest alterative nature, and appear to co-operate in a direct manner with a tendency to restoration which had already begun; or, as in hooping-cough, where the restorative process is often easily introduced. Our remedies, therefore, are curative by substituting new pathological conditions, and nature does the rest; and it is only with a view to a right interpretation of their *modus medendi* that I have any disposition to depart from established phraseology, or to confound the operation of remedies with that of the ordinary causes of disease (§ 137, 143, 150–152, 177–182, 185, 893 *c*, *d*, 1059).

That what I have now stated as to the substitution of one pathological state for another in the cure of disease, and that this is the only contribution which nature receives from art, seems to be abundantly obvious; though the proposition which I have thus made appears not to have been a subject of consideration. As a change arises when efficient agents operate, and as that change, by the supposition, is not a restoration of the morbid to the natural state it is necessarily a new pathological condition. And so, also, of the unaided changes which Nature institutes, till the natural state is fully established. Bloodletting, and emetics, it is true, will be sometimes followed, as in fevers and in croup, by an almost immediate subsidence of the symptoms; but, during their rapid operation, they have only introduced new conditions of the pathological states which enable the morbid properties to resume, at once, a near approximation to their healthy standard. It is certain that art can accomplish nothing more.

902, *a*. I now proceed to recapitulate the manner in which remedial agents produce their effects upon parts remotely situated from the direct seat of their application; and this, as I have formerly said, is through remote, contiguous, or continuous sympathy; the agents exerting their direct impression upon the parts with which they are in contact. Remote, and evidently, also, contiguous sympathy, are conducted by the nervous power through the medium of the cerebro-spinal and ganglionic systems; while, as I have also endeavored to show, continuous sympathy is independent of the nerves.* When, however, these enter into the structure of parts, as in animals, they have a certain contingent participation. But their primary connections may be wholly severed, and disease may be yet propagated continuously along the

*Continuous influence of these Institutes (§ 129 *c*, *f*, 498 *a*).

part to which they appertained; as we observe, also, in plants. It appears, therefore, that in these examples, the morbid condition is extended, in a continuous manner, from the organic properties of one point to the next in apposition (§ 185, 233, 461, 475½, 647½, 746 *c*).

902, *b*. I have variously shown that the nervous power is capable of acting as a vital stimulus to the organic properties, is liable to be variously developed by morbific and remedial agents, and to be so modified in its nature according to the virtues of such agents, that it produces, more or less, in diseased parts, remote from the direct seat of the morbific or remedial action, the changes which the agents themselves would exert were they applied directly to the remote organs. The nervous power may be, also, equally determined with a morbific or curative effect upon the organic properties and actions of the great nervous centre; or upon any of its radiating parts. The philosophy is also exactly the same when one diseased part gives rise to disease in parts that are remote; and when disease in remote parts, that has been maintained by affections of other parts, subsides in consequence of the restoration of the latter, it is owing to the removal of a pernicious modification of the nervous power that had been constantly propagated by means of the latter upon the former (§ 409 *k*, 891½ *k*).

902, *c*. The type of the foregoing philosophy exists in various processes which are naturally going forward in the animal body. A single example of this nature is a key to the whole labyrinth. Thus:

"The whole system of respiratory nerves can be excited to action by irritation of any part of the mucous membrane, from the mouth to the anus, from the nostrils to the lungs."

Mechanical irritation alone is adequate to the greatest variety of effect, as broadly stated in the foregoing law of sympathy. Tickling the fauces provokes vomiting, irritating the anus produces purging, and thus are the muscles concerned in respiration, and those of the stomach and intestine, and even the liver and the salivary glands, brought into unusual action by slight mechanical irritation of the fauces or anus. Irritate the same tissue in the nose, and the respiratory muscles are thrown into another mode of action; irritate the larynx, and another mode is excited; call up the recollection of the finger in the fauces, and the mind may determine all the sensible results of an active emetic, as set forth in § 500 *i–m*, *o*, 503, 514, 891½ *k*, 905 *a*.

There is the great principle. It is greatly the work of the nervous power, excited in one series of the cases by impressions transmitted from distant parts to the nervous centres, and in the other by the direct operation of the mind upon the same central parts. It is through that principle that emetics and cathartics produce their most sensible manifestations, and the same is concerned in all their less obvious influences upon every part but the intestinal mucous tissue, except as continuous sympathy may contribute a part of the influences which extend to the liver, &c. It is the same as concerns the respiratory movements, which, as I have said, may be regarded as an elementary exemplification of the most entangled operations of the nervous power. The modus operandi may be repeated in its exemplifying relations to this subject. The point of departure, in the process, is the mucous tissue of the lungs, from which the impression is transmitted through the pneumogastric nerve, as well as through the ganglionic, to the brain and spinal cord (especially the medulla oblongata), where

the nervous power is excited and reflected upon the organic properties of the muscles of respiration through the various motor nerves of those organs. These muscles are, in consequence, thrown into action, and the thorax expanded (§ 233¾, 500 *e*, 514 *l*, &c.).

If the foregoing simple, demonstrable exemplification be duly comprehended, there can be no difficulty with all the rest. In the example of sneezing, as a consequence of the action of light upon the eyes (§ 514, *l*), the process is more complex, and shadows forth the far more intricate movements that are in progress,—the almost endless reflex nervous actions which are taking place,—during the progress or decline of disease, or those which are set up by the operation of an emetic, a cathartic, &c. (§ 1040).—NOTE D p. 1114.

902, *d*. Physiological examples of the foregoing nature abound in the animal organization, and supply the most ample ground for the interpretation of the effects of remedial and morbific agents in their wide range of influences. The modifications of reflected nervous actions that relate to the respiratory system alone, as in coughing, crying, laughing, yawning, &c., are a fruitful field of inquiry into great and precise laws, and extensively applicable to the philosophy of medicine. The only difference is, that, when disease is established in a part, or when remedial agents operate, the organic properties of the part are altered in their nature, and, of course, the organic actions over which they preside. A specific impression, in the latter cases, is transmitted to the nervous centers, the nervous power more or less modified in a corresponding manner, and from thence reflected through other nerves, or other fibres, to the same or other parts, and, according to the nature of the modification, disease will be produced or mitigated in those parts. However complex, and variable, therefore, the phenomena, nothing can be more simple than the principle through which all these changes are produced (§ 233⅘, 475½, 647⅕, 893½).

902, *e*. When an emetic operates, the modus operandi is essentially similar to what happens in respiration. The mucous tissue of the stomach being the point of departure, a different influence is propagated to the nervous centres, corresponding with the nature of the exciting cause, with the special vital constitution of that portion of the mucous tissue, with the compound nature of the stomach, with the special relations of this organ to the central parts of the nervous system and to the respiratory muscles, &c. (§ 138, 149, 150, &c.), while the nervous power is also modified in its nature according to the peculiar virtues of the emetic (§ 227). The most sensible result, as in respiration, depends upon the reflection of the nervous power upon the respiratory muscles, while another current descends through the motor fibres of the pneumogastric and sympathetic nerves to the muscular tissue of the stomach. If the emetic operate also as a cathartic, then a new chain of actions is established, in the same way, upon the abdominal muscles, while a current of the nervous power is propagated upon the muscular coat of the intestines (§ 233¾, 889 *a–f*).

902, *f*. But, in the foregoing case, something more happens than in the natural processes. Here the exciting cause possesses peculiar virtues, is of a morbific nature, and it not only makes peculiar impressions upon the alimentary mucous tissue, according to the exact nature of its virtues, but it modifies the nervous power in a corresponding manner. If the stomach be the seat of disease, the direct impres-

sion upon that organ, or the change which an emetic may effect in its vital condition, will be more or less varied from what is exerted in a state of health. It may, therefore, prove curative to the stomach more or less by this direct influence (§ 514 *b*, 658). But the nervous power is also modified according to the impression produced upon the organic properties of the stomach, and is sent abroad, with alterative effect, upon various parts of the system. According to a law by which diseased parts are far more susceptible of influences from vital stimuli than such as are not diseased, the modified nervous power will fall with far greater effect upon the former than the latter. The organic properties and actions of one may be profoundly and permanently affected, while the latter are only moderately and very temporarily influenced. In consequence, also, of the deep effect which the modified nervous power exerts on the diseased parts, they may return, at once, to their natural state (§ 841, 2, *b*, 143, *c*, 148–151, 855, 895, 481 *d*).

But the milder influences which are set up by the nervous power upon parts in health, or in comparative exemption from disease, play, also, their part in the salutary process. If the emetic operate also as a cathartic, impressions are transmitted from the intestinal mucous membrane to the cerebro-spinal system, the nervous power developed and modified according to the nature of these impressions, and radiated abroad as when the result of the action of the emetic upon the stomach, and with effects corresponding to this new development and modification of the nervous power (§ 227–233$\frac{4}{5}$, 514 *h*, 889 *a*).

Again, the skin is influenced in the foregoing manner, and this organ transmits that impression to the cerebro-spinal axis, and develops and modifies the nervous power accordingly, when it is, as in the other instance, reflected abroad, and is felt by various parts according to their degrees of susceptibility. Various other circles of modified nervous influences set in, and become too complex for analysis; but all may fall with one concurring curative effect upon the diseased susceptible organs. Thus every part may have an allotment in the curative process; as more distinctly expounded in foregoing sections (§ 143, *c*, *and references*, 500–514, 516 *d*, no. 6, 863 *d*, 889 *g*, 893 *a*, *c*).*

902, *g*. We thus see that when vomiting springs from the operation of tartarized antimony, and often from ipecacuanha, it is only one of the consequences, and a minor one, of the peculiar irritation of the gastro-mucous membrane. Other and far more powerful influences are determined, simultaneously, upon the organic properties and actions of distant and diseased parts (perhaps as distant as the most remote extremity), by the same nervous power that shook the respiratory organs during the act of vomiting. And often, indeed, does it happen that those influences are propagated with the most profound effect when the act of vomiting fails of being consummated; and nausea, alone, shall send with prostrating force the modified nervous power over the whole system; when we shall see it simultaneously bathing the whole surface with perspiration; pouring the saliva from the mouth; breaking down a tumultuous excitement of the heart and arteries; starting on the instant a torrent of bile, and an equal effusion from the intestinal mucous membrane; and, at the next moment, presenting a magnificent play of reflex actions for the evacuation of the fluids, after the manner of an active purgative,—these very effusions, also, instituting other circles of reflex action, which join in the great

* See NOTE Cc p. 1132.

work of curative movements. Should vomiting now follow, then shall you speedily see the vital energies returning,—the cold, pale skin giving place to a florid hue and a warm perspiration,—the sunken features starting into the fullness of health,—the gastric suffering gone as a luxury obtained,—the general whirl of anxiety and distress converted into calm tranquillity,—the headache dissipated,—the twang of the croup, or the grunt of pneumonia, no longer sounding an alarm;—and, all this stupendous succession of events, from the beginning of nausea to the restoration of the vital energies and the near resolution of disease,—composing a most astonishing consecutive series of reflex actions,—may require less time than I have hastily employed in this general allusion to the subject. And now can it be entertained that this has been the result of absorption, or that the laws of chemistry or physics have had any connection with the phenomena?*

902, *h*. The foregoing may be taken as an example of the principle which concerns the *modus operandi* of all curative or morbific agents, whether physical or mental, and of all the developments of disease that arise as sympathetic consequences of each other. In respect to emetics, however, it should be considered that all do not produce the foregoing effects, and that with the exception of the act of vomiting, the results will depend upon the precise nature of the emetic, or the manner in which it modifies the nervous power and thus impresses the organic properties. This explains the difference in results between tartarized antimony, ipecacuanha, sulphate of zinc, warm water, tickling the fauces, the mechanical irritation of undigested food, the shock of a fall, of a surgical operation, sailing, whirling, offensive sights, offensive odors, loss of blood, and even their recollection; while the nature and effect of the greater number should lead the philosophical inquirer to pause at the physical doctrine of absorption, and survey the other difficulties with which it is fatally encumbered.

902, *i*. When the alterations, of a sympathetic nature, are more slowly produced, as when mercury induces salivation gradually, and brings the whole system under its influence, or when small, and repeated doses of tartarized antimony overcome inflammations of the lungs, &c., the nervous power is developed and modified at each successive dose, and the repetition of its reflection upon the organic properties of diseased parts remote from the stomach establishes progressive changes, till an absolute condition of disease may be induced in certain parts, as when mercury salivates; while the analogous influences which are exerted on parts already diseased supplant the naturally morbid states by others of an artificial nature, from which the organic properties are able to return to their healthy condition. But these impressions must be frequently repeated; for if the interval be long between the administration of the doses of such agents as only produce their effects in a gradual manner, the diseased conditions, not being placed in the way of the recuperative tendency, will throw off the artificial impression, and the original intensity of disease will be thus restored. The process which I am now considering is an example of the *cumulative* effect of remedial agents, some of which are much more remarkable than others, and the ultimate results are pronounced with varying degrees of suddenness. This is also influenced by peculiarities of constitution, or of susceptibilities of the organic properties to changes now under consideraton; and therefore is it, that sal-

* See § 409 *k*, 476½ *h*, 514–516, 943 *a*, 944 *c*, 1084

ivation may be speedily induced in one subject by less than a grain of calomel, while no amount of the remedy will produce this effect in others. And so of the morbific effects of digitalis; an agent, also, which exemplifies the suddenness with which cumulative agents may produce an explosion of disease, although no symptoms had admonished us of its approach. This principle concerns, also, the predisposition to disease which is formed by miasmata, the virus of small-pox, of hydrophobia (§ 516 *d*, no. 6, 647½, 657 *a*, 666, 904 *bb*, 1059).

902, *k*. The permanent operation of the nervous power in particular parts of the animal fabric, as in the sphincters, supplies an elegant parallel with the foregoing uninterrupted influences of the same power as developed by remedial or morbific agents. This power operates as a perpetual stimulus to the organic properties of the muscles just mentioned, in the same way as the fæces and urine stimulate the mucous tissue. And now, if we mutilate the inferior part of the spinal cord, or observe the sphincter ani when relaxed in bad cases of apoplexy, or regard its condition when the spinal cord is merely divided, we shall see the relative bearing upon other organs of these two parts of the nervous system in their connected state, but with injury of the brain, and how the spinal cord is capable of an individual influence (§ 473–475, 476½–481, &c., 514 *g*, &c.).

902, *l*. When mental causes operate in the cure, or production of disease, they act directly upon the cerebro-spinal axis, and develop and modify the nervous power according to the nature of each mental affection; and, as in the case of physical agents, the nervous power thus developed and modified may be determined as well upon the organic properties of the brain and spinal cord, as upon other parts. The blow upon the region of the stomach, or the opening of a thecal abscess, which have destroyed life on the instant, operate in the same way as the paroxysms of anger, or of joy, which have been as suddenly fatal. In these cases the nervous power is alike reflected with a fatal effect upon the brain as well as other important organs (§ 479).

902, *m*. A more intricate example may now be presented relative to those natural means of cure which occur in a former section; such as change of air, exercise, &c. (§ 855). These are all positive remedies, and, of course, they have their modes of operating. One example will open the philosophy of the whole. How, then, does change of air suddenly arrest an obstinate form of the hooping-cough? There is gastric as well as pulmonary disease, and the mucous tissue of the stomach is preternaturally susceptible to the influence of many causes. The air exerts its impression upon the lungs, and upon the general surface of the body. But, there must be other agencies in operation before the lungs will experience relief. These agencies appertain to the nervous power, which is developed by the foregoing impressions, and reflected upon the stomach and other abdominal organs. If there be disease here, it is more or less relieved, and the more so the greater will be the ultimate salutary impression upon the lungs. The abdominal impression is transmitted to the nervous centres and the nervous power reflected with its alterative influence upon the pulmonary mucous tissue, and thus ends the disease. The spasmodic action of the respiratory muscles is, of course, arrested by withdrawing the preternatural operation of the nervous power from those muscles, as a consequence of the subsidence of disease in the pulmonary mucous

tissue (§ 902, *c*). And so, when change of air promotes the healing of ulcers upon the extremities; and should they not be complicated with derangement of the abdominal organs, one of the sure evidences that the foregoing is the modus operandi of this remedy is the improvement of appetite which commonly precedes any manifest abatement of the remote affections. The same philosophy applies, also, to the control which air and exercise frequently obtain over phthisis pulmonalis (§ 514 *c*, 525 *c*, 527 *b*).* It is conspicuously seen even in the operation of morbific causes; and the two aspects of the subject go to illustrate each other (§ 657, *a*). The principle is of the utmost importance in medicine. Its laws are precise. Their knowledge will lead to a greater dependence upon the functions of organic life (§ 878, 890½ *d*. But these problems lie in the depths of physiology.

903. It is important to consider the distinction between impressions which are made, in organic life, upon *irritability* and *sensibility* by vital agents, whether natural, morbific, or remedial. The latter property is the subject of impressions particularly in animal life; though it becomes more or less involved in organic, in all its natural modifications, by the accidents of disease. But the special modification which I have considered under the name of *sympathetic sensibility* performs the important part of transmitting impressions to the nervous centres when they give rise to sympathetic movements in organic life. Indeed, the whole rhythmic action of the organism is maintained by the transmission of influences from all parts to the brain and spinal cord through this modification of sensibility, and a consequent reflected action of the nervous power upon all the organs, as each may require the harmonizing influence of this great regulating property of the vital principle (§ 233¾, 1037, *b*), through the potential sympathetic nerve.

The foregoing is the chief agency which sensibility exerts in organic life, and the nervous power no other than that of a vital agent, acting, like other agents, upon *irritability*, from which the influence is imparted to *mobility*. This we have also seen to be equally the case in animal life, when voluntary motion is performed. In all the cases, however, where *perception* is excited, either *common* or *specific sensibility* is more or less interested, though neither modification takes any part in the organic or animal movements (§ 233⅘, 524 *d*, no. 7, 647½, 893½).

If the brain, or any part of the nervous system, be the seat of disease, of irritation, &c., the preternatural development of the nervous power is, as we have seen, *direct*, and propagated *directly*, and with very various effects, upon distant parts. In this process the motor nerves are alone concerned, and therefore sympathetic sensibility is not brought into operation. It is exactly the second part of the process which takes place when influences are transmitted from one organ to another through the medium of the nervous centres. There is, therefore, no difference in the principle. The experiments of Wilson Philip, &c., illustrate the *direct* method (§ 477, &c.); the constitutional action of remedies the *indirect*, or by reflex nervous action.

904, *a*. In considering the philosophy of the effects of the nervous power it is important to regard its nature as liable to modifications from the slightest influences, both physical and mental. This is evinced by all the phenomena, is analogous to the natural and artificial modifications of irritability and sensibility; and according to its modifications, and other concurring causes hitherto expounded, it produces

* See NOTE F p. 1114.

changes in the organic properties and functions; establishing or removing disease, or killing in an instant.

I say, therefore, again and again, as more deeply seated than all things else at the foundation of medical philosophy, the nervous power is not only variously excited, exalted, or depressed, or modified in its kind, and produces influences upon remote parts according to these changes, but it is reflected upon particular parts according to their existing susceptibilities, the nature of the remote cause, and the part upon which the remote cause may operate (§ 233¾). Thus, as I have said, one impression from cold, as a blast of cold air, or a drop of cold water upon the skin, will rouse the respiratory muscles. Another impression from the same cause will excite catarrh, or pneumonia, or pulmonary phthisis, or articular rheumatism (§ 649 *b–d*, 657, &c.). Mercurial ointment will determine the nervous power specially upon the salivary glands, and liver, and the same effects arise from the action of mercury upon the stomach. Cantharides, internally or externally applied, irritates the neck of the bladder. One degree of impression by tartarized antimony upon the stomach determines the nervous power upon the respiratory muscles, and vomiting is the consequence; while it simultaneously reflects the same power upon the skin as it does in smaller doses, and of which perspiration is a consequence,—and so on. But these examples embrace only certain parts of the influences in each case; while in others they are far more complex,—one sympathetic result becoming the cause of others, till, through a single impression upon the organic properties of the skin, various circles of alterative reflex nervous actions may be instituted. Narcotics induce peculiar modifications of the nervous power when they are administered by the stomach, and the power thus modified is not only reflected upon various distant parts with effects corresponding with its modifications, but especially, also, upon the organic and animal properties of the brain and spinal cord. Hence the obtuseness of the senses, and the venous congestions of the brain, which follow their improper administration (§ 891½ *g*, *k*).

904, *b*. We have seen that hydrocyanic acid, strychnia, &c., will destroy life, when applied to the tongue, before one act of inspiration can be made, and that, when swallowed by man in speedily fatal doses the odor of the acid is indistinguishable in the blood, or within the organism (§ 350½ *p*, 827 *d*). Wedemeyer and Müller testify to the fatal effect of one drop of the hydrocyanic acid, within a single second, when introduced into *the eye* of a rabbit. And so of strychnia. It is also allowed by Müller, who defends the doctrine of absorption in all cases, that from a minute to two minutes are necessary to one round of the blood's circulation. The case is a plain one; the contradiction obvious (§ 494, *dd*). Besides, the action of these poisons must begin at the instant of their contact with the living parts, and what is progressive throughout the entire second of time is physiologically the same as at the beginning of the second. Magendie kills "the most vigorous dogs" by applying to the fauces one drop of the hydrocyanic acid, "after two or three hurried inspirations." Pereira says that he "once caused the *instantaneous* death of a rabbit by applying its nose to a receiver filled with the vapor of the pure acid. The animal was killed without the least struggle." And so did Magendie. Pereira adds, that in cases of this nature, "the rapid action of the poisons seems

almost incompatible with the idea of their absorption."—PEREIRA's *Mat. Med.*, p. 27, 242. The experiments by Stilling and Van Deen settle the question as to absorption (§ 494). Consider the action of opium. Apply it to the mucous tissue of the intestine, and the local impression is such that it immediately arrests the peristaltic movements. Apply it to the surface of the brain, and it instantly lessens the action of the heart and capillary blood-vessels, &c. Now combine these phenomena, when opium exerts its direct action upon the stomach, and indirectly upon the heart, capillary system, &c., and consider the natural relations between the stomach and nervous centres. Take a substantial, physical fact, as supplied by the advocates of absorption. Thus (NOTE AAA p. 1146):

"It is very singular," says Sigmond, "that a pill of opium, administered by the stomach at night, will be *vomited up* in the morning, *after having produced its narcotic effect.* This is an observation which Van Swieten originally made."—SIGMOND's *Lectures*, &c.

My doctrine of alterative reflex nervous action clears up the obscurity, and admits of the only explanation (§ 512, *b*, 891½ *k*).

"I am acquainted with a physician in London," says Sigmond, "who, on taking opium, although in a very minute quantity, will have over the surface of the body a scarlet efflorescence" (§ 891, *e*).—*Ibid.*

Is not this phenomenon due to the same principle as that which is concerned when indigestible food occasions analogous eruptions, or when they spring up, as in infancy especially, from gastric and intestinal derangements, or when the blotches of a surfeit vanish during the operation of an emetic, or as croup disappears under the same influence? Turn to the experiments of Philip, Alston, Hall, Stilling, Buniva, Van Deen, Kreimer, Procter, Girtanner, Johnson, &c., and they will be found to confirm my conclusion (§ 399, 483, Exp. 21, 484, 485, 828 *b*),* that they depend upon alterative reflex nervous actions.

The following are other facts which demonstrate the local operation of remedial and morbific agents, and the dependence of their constitutional effects upon the laws of reflex nervous action. Thus:

"An *imponderable* quantity of atropia," says Pereira, "is sufficient when applied to the eye, to cause dilatation of the pupil."

Now consider the effect of this "imponderable quantity" in connection with the analogous effect of imponderable light (§ 514, *k*), and the modus operandi of the latter will be found to coincide with that of the former. The cases are remarkably parallel, and the more interesting as showing the transmission of influences through sympathet-

* In connection with what I have incidentally said in a former section of the advantages of opium in the cerebral congestion which is induced by the intemperate use of alcoholic liquors, and which constitutes a prominent part of delirium a potu (§ 891, *r*), I may say that we witness here, in the manner in which the irritability of the nervous tissues is relieved, and the subsidence of disease as a consequence, not only the special modification of irritability, according to the nature of the remote cause, but also the special adaptation as a remedial agent of what is morbific in cerebral congestions as induced by any other cause (§ 150, 151, 191, 650, 662, 686 *b*, 976 *b*, 1058 *y*).

But, although a knowledge of the remote causes aid us greatly in the treatment of disease, we may not proceed upon this consideration alone, as is commonly done, more empyrically, in delirium a potu. Opium rarely fails of being pernicious, in that affection, if there be much gastric or hepatic derangement, until this condition be more or less overcome. It is always useful to premise a cathartic, of which calomel should generally form a component part; and, in many cases, bloodletting is an indispensable remedy. But here, again, the exact pathology, and the complications of the disease, should be well ascertained, or bloodletting may prove as pernicious in some, as opium does in others.

There are also certain states of the brain attendant on maniacs in which opium is beneficial; but we must be sure of the right, or we shall be sure to go wrong

ic sensibility as pronounced in an expanded nerve and as implanted in the skin of the eyelid, or in the tunica conjunctiva, and therefore through different sensitive nerves, while in all the cases, the motor nerve, and the part which is impressed by the nervous power are exactly the same (§ 233¾). It is also worthy of remark, as exemplifying the modification of the nervous power by preternatural agents, that the motion of the iris is very different under the different influences of the remote causes (§ 74 *a*, 188½ *d*, 514, *l*, 1042).

"It is a very interesting fact," says Sigmond, "that the application of hyoscyamus and belladonna to the eye was not applied to any practical purpose until a gentleman by accident applied a piece of the herb to his eye, when the effect remained for *three weeks*."

He states, also, that a dilatation of the pupils may be produced by only approximating the leaves of hyoscyamus or belladonna to the eyes. This is a closer parallel with the effect of light than the preceding statement by Pereira (p. 344, § 516 *d*, no. 6).

Observe how many individuals are liable to violent erysipelatous inflammation over the whole surface of the body from approaching only within a few yards of several species of rhus; while, on the other hand, many are entirely insusceptible of its action, as many are of the constitutional effects of mercury (§ 585, *b*).

Here, again, is another fact, coincident with the foregoing, and which also elegantly illustrates the different natural modifications of the organic properties; even in different parts of the same continuous tissue (§ 133, &c.). "As an enema," says Sigmond (I quote from the advocates of absorption), "hyoscyamus, in any quantity, cannot be given." Authorities are quoted to show that it then produces delirium, and even apoplectic symptoms, and also when the "fumes were inhaled" (§ 827 *b*, 1066)—LECTURES in *London Lancet*, Feby. 18, 1837.

The snuff which regales the nose, and the tobacco which equally delights the mouth, are violent poisons to the intestinal mucous tissue; and the constitutional results harmonize with the local effects in either case (§ 133, &c., 150, 151). Again, if remedial or poisonous substances act by absorption, why is tobacco smoke so innoxious when inhaled by the lungs, and yet so deleterious when swallowed, or when conveyed into the rectum? Most remedial agents, indeed, produce constitutional effects according to the natural vital modifications not only of the mucous, and other tissues of different parts, but of one continuous tissue, as the mucous membrane of the eyes, nose, fauces, œsophagus, stomach, small and large intestines, larynx, trachea, and lungs. Where would philosophy be; where our interpretation of these various consequences, if we followed the chemist in his physical views of life? What would tobacco affect in such a case? Would it nauseate by affecting chemical affinity, or cohesion, or elasticity, or would the nose or the mouth enjoy through any such properties of matter,—or would galvanism help our understanding? Is it through any such properties that we feel the smart when the fire burns? Does not Pereira supply an important fact against his general doctrine of operation by absorption when he defends a moderate practice of opium smoking,—especially as the whole volume of smoke is drawn into the lungs?—(*Mat. Med.*, p. 1293.) Shall we not rather look to what is known of the natural modifications of irritability in the mucous tissue of different organs? If opium offend the stomach, the principle is the

same as when urine excoriates the mucous membrane of the lungs, and thus produces the most violent reflex nervous actions. But the distinguished author above quoted shall lay down our principle himself. Thus:

"Sir B. Brodie," he says, "found that an infusion of tobacco, thrown into the rectum, paralyzed the heart, and caused death in a few minutes. But if the head of the animal be previously removed, and artificial respiration kept up, the heart remains unaffected; proving that tobacco disorders this organ through the medium of the nervous system only" (§ 484, *b*).—*Ibid.*, p. 869. Also, NOTE B p. 1113.

Should we not rather say, through the medium of the brain in its connection with the organic nerve, while other parts may suffer reflex nervous actions through the spinal marrow, or even the ganglionic system alone. And now contrast with the foregoing peculiarities of tobacco and opium the fact that the inhalation of the fumes of hyoscyamus produces vertigo, tremors, laborious respiration, &c.; and that hydrocyanic acid, in the quantity of a drop, or in vapor, on account of the coincident relations of its virtues to the naturally modified organic properties of various parts, is instantly fatal, whether applied to the mucous tissue of the eyes, nose, mouth, stomach, or lungs. And so of the spirituous extract of nux vomica. If absorption be good in some of the cases, it should be equally so in the others. Consider, too, how the habitual use of narcotics reduces the susceptibility of the stomach to the influence of each one, respectively, and not to the others, and how the constitutional effects go on, *pari passu*, in the ratio of the local effects. And consider, also, how music assuages suffering, or the expectation of the dentist relieves toothache. And why, according to the doctrine of absorption, should not medicines produce the same constitutional effects when injected into the bladder, as when administered by the stomach? Are you doubtful as to the manner in which certain substances produce their constitutional effects when applied to the skin, as mercury and tobacco, for example? Consider the foregoing case of hydrocyanic acid; or how an issue relieves deep-seated inflammation; or, again, how belladonna, or hyoscyamus, when applied to the lids of the eyes, as when to the stomach, produces dilatation of the pupils (§ 1066, p. 838, § 1057½).

904, *bb*. Let us observe the constitutional effects of tartarized antimony when administered in small and repeated doses. This substance possesses, in a general sense, the power of lessening the irritability of the stomach (in relation to its own virtues), where the doses are small at first, and gradually increased. From this principle, indeed, results the necessity of increasing the doses as far as they may be borne without nausea, for the purpose of maintaining the same influence upon disease as is exerted by the first and smaller doses. In this way, in certain affections, as in articular rheumatism, we may sometimes rapidly increase the doses from the sixteenth of a grain to two grains, although the first dose shall have actually produced vomiting, while the two grains are borne without nausea. It is also certain that this progressive increase of the remedy, as far as may be admitted by the stomach, is indispensable to the full influence upon disease which was exerted by the smaller doses before the remedy had subdued the irritability of the stomach (§ 516 *d*, no. 7, 558, 578 *d*, 841).

Now were the physical, and not the physiological, doctrine true,

there should be no necessity for this regular and rapid increase of the doses. The nearer, indeed, each dose approaches the point of nausea so will the general arterial excitement, and local inflammations, be held in subjection; from which it is plainly manifest that the remote effects depend upon the amount of influence produced upon the stomach. And so of opium, and all the narcotics, and, indeed, of various other agents which are freely assumed to operate through the circulation. As to antimony, croup often subsides when nausea begins.

But again, on the contrary, we may obtain an exactly opposite series of results from tartarized antimony; by which we prove our proposition by the converse of the foregoing phenomena. We may begin the treatment by one eighth of a grain without producing nausea; but in an hour or two afterward, a repetition of the same dose nauseates the stomach, and prostrates the whole system. Again, at the same interval, we repeat the same dose and vomiting ensues, accompanied by still greater constitutional effects. We then reduce the quantity to the twelfth of a grain and again we have nausea and vomiting, with still greater constitutional results. We go on to reduce the dose in this manner, and, as I have witnessed in adults, it has been necessary to diminish the quantity to the thirtieth part of a grain to avoid protracted nausea, and a general prostration of the system. Here, then, the remedy not only continues to nauseate the stomach in greatly diminished doses, but, as in the opposite case, there is a constant ratio between its impression on the irritability of the stomach and its constitutional influences and its special effects on diseased remote organs. However the dose may be diminished, so long as it impresses the irritability of the stomach, it breaks down the general arterial excitement, and often overthrows inflammation just as fully, and rapidly, as when two grains are administered with a similar effect upon the stomach. Nor is this all which antimony opposes to the doctrine of absorption; since in the cases first supposed, when it finally produces nausea after repeated and gradually-increased doses it does not reduce the irritability of the stomach after that dose, as after the beginning of the remedy, and when it did not produce nausea. On the contrary, the gastric irritability is now brought up to a full relation to the remedy in that last dose, where it either remains permanently for some time, or is quite as apt to increase in susceptibility to the antimonial influence, so that it may be necessary to diminish the next following dose to avoid a renewal of the nausea, and perhaps vomiting. In the mean time, the effects on the constitution, and on remote disease, are exactly conformable to the amount of influence upon the stomach. Clearly, then, its effects depend on reflex nervous actions.

904, *c.* Pereira has rendered our best standard work on Materia Medica liable to the objection which I am now considering, as he has, also, to that of reasoning from the effects of remedies on man in health, and even upon the naturally modified constitution of animals and plants, to the altered susceptibilities of man as they exist in disease. Of tartar emetic, he says, we do not know "the mode in which it produces its curative effect." And again, a universal opinion—

"Shall we deny the efficacy of bloodletting in inflammation, of mercury in syphilis, of cinchona in intermittents, and of a host of other remedies, simply because we *cannot* account for their beneficial effects? The fact is," he continues, "that in the present state of our

knowledge, we cannot explain the *modus medendi* of a large number of our best and most certain remedial agents."—(PEREIRA'S *Mat. Med.*, vol. i., p. 417. 1839.)

This supposed ignorance is mostly predicated of the failure of detecting the medicines in the circulation; but will it apply to such observers as explain their *modus operandi* on other principles, and in conformity with well-established facts? If "bloodletting be efficacious in inflammation, mercury in syphilis," &c., they are so through great and immutable laws; and shall we rest in ignorance of those laws because we cannot deny the efficacy of the remedies? Is it not this very common representation of the topics before us, and of the phenomena of living beings, which has led to so general a disregard of the great principles in medicine, and to the revival of the exploded creeds of the iatro-chemical and iatro-mechanical philosophers? Or is it any argument against the interpretation of the properties and laws of organic beings, of their modifications in disease, of the *modus operandi* of remedial agents, as set forth by one inquirer, that fifty different and conflicting systems have been projected by others? Such, indeed, must be the position of every disputed topic when universal truth shall ultimately prevail. The argument, therefore, however common, is necessarily fallacious (§ 892, *b*, 905¾, 829, 830).

There is no objection to admitting that all remedial and morbific agents find their way, very scantily, into the circulation, excepting as it regards the matter of fact, and a respect for those principles which nature has ordained for their exclusion so far as to prevent their ingress in injurious quantities. No conclusions, as I have shown, can be formed from the effects of injections into the circulation; which are the rudest facts in relation to a topic of this nature. It therefore becomes the merest assumption to affirm that the minute proportions of medicines, which may force their way through the well-guarded portals of the organism, produce those remarkable results which we witness after their administration by the stomach; while we are met at the threshold of the inquiry by the clearest interpretation of their *modus operandi* in the perfectly demonstrable laws of sympathy, in a stupendous display of reflex actions of the nervous power in the natural conditions of the body, and as modified by a vast variety of experiments, and by the morbid processes that are perpetually before us.

904, *d*. Again, take the grand characteristics of the cinchonas, arsenic, calomel, and the whole group of agents for intermittent diseases. Of cinchona, Pereira says (after having expounded its operation as a tonic through the process of absorption), that in intermittent diseases its "*methodus medendi* is quite inexplicable."—(*Ibid.*, vol. ii., p, 1002, 1006. 1840.) But, is not its mode of operation just as intelligible in one case as in the other? Does not the whole system of nature, where common results are concerned in any integral part, enforce the belief that the same laws are concerned in both cases; and do not all the relative facts in physiology, all that is known of the properties of life, and of the constitutional effects of vital stimuli of any denomination proclaim the fact, that nature is just as consistent in this instance as she is in the simple principles which determine the phenomena of gravitation, of chemical affinity, of the attraction of cohesion, of repulsion, &c., or, in more sensible physics, of electricity, of light, of magnetism, &c.? If we refer, as does Pereira, to the effects

of cinchona as a tonic upon the healthy system, we must explain the *methodus operandi* before we can apply it in the least to any paralle effects upon morbid and enfeebled states of the system. But we may not speak of "augmentation of cohesion of the organic mass," &c. (§ 890, 890½).—*Ibid.*, p. 1002. These are only effects of an antecedent operation, in which the whole *modus operandi* consists (§ 842). But the mode in which cinchona produces its effects in the perfect organism being just as obscure as in diseased states, we start with our interpretation of its *modus operandi* in intermittents just as we do of the mode in which cinchona produces its fullest effects in health; or raises the vigor of the stomach, sharpens the appetite, and braces up the animal man, in dyspeptic affections.

Now the mode in which cinchona accomplishes these last results is no more obvious than its action as a febrifuge. One must certainly be as plain as the other, since the essential influences and changes are exerted upon the organic properties of living parts, which are governed by simple and immutable laws. To explain the operation of a given cause upon two principles where the results are of the same genus, and nearly of the same species, would be to disjoint nature completely, and to render her a deformity.

With this fundamental principle, we move forward to the interpretation of the effects of cinchona when it exasperates or produces disease; and so of other morbific agents. All the results, as they vary from those which follow the ordinary stimuli of life, depend upon the mutability of the organic properties and actions. Upon these, morbific causes, like the natural vital stimuli, make their whole impression; but they go farther in that impression than the natural stimuli of life. That is to say, they make their impression so profoundly, and in virtue of their peculiar attributes, as to alter the natural condition of the organic properties and actions; and this alteration constitutes disease. All that follows are but mere "sequelæ." Remedial agents, as we have seen, are capable of doing the same thing; and when direct in action, they operate upon the same principle. It is for this reason, therefore, that they produce disease in the healthy organism; and when they contribute to the cure of disease, it is in virtue of that morbific action which they exert on healthy parts. They are a class of morbific agents, however, which produce only such diseases, in health (if not administered in great excess), as are of a transient nature; and when, therefore, administered for the cure of disease, they induce a morbid state more favorable than the pre-existing to the natural tendency of morbid organic properties and actions to return to their healthy standard (§ 892 *b*, 893, 901, 1059).

Thus we get at a common principle of the *methodus operandi* of cinchona as a *tonic*, as a *febrifuge*, and as a morbific agent; and it is equally applicable to all other remedies which possess absolute remedial virtues. This philosophy enables us at once to understand how arsenic, cobweb, opium, alcohol, mental emotions, and almost every thing else, are, like cinchona, more or less curative of intermittent fevers; and though the alterations which are directly instituted by these various agents are unlike in all the instances, and correspond with the peculiar virtues of each agent, each one induces such changes in the organic properties as enable them to take on their natural tendency toward a state of health,—some being more conducive than

others, and either liable to exasperate the disease. We thus see, also, how it is that our remedies must be well adapted to the existing pathology, or they will prove morbific; since their operation is as well regulated by the nature of the morbid conditions as by the virtues of the remedies (§ 79, 150, &c., 857, 890½ *d*, 892 *d*). We must look for the reason of this ready subversion of intermittent fever to solidism and vitalism. We must regard nature in her recuperative efforts as strongly pronounced during the periods of intermission, and thus learn from her that the morbid properties of life may require but a slight impression to establish an unintermitting tendency toward a state of health (§ 177–182, 557 *a*, 756 *a*, 775).

That there *is* a *methodus operandi*, in all the foregoing cases, is too certain to be questioned; and such being the fact, it is quite a becoming occupation for the human mind to interrogate its nature; or as the Wise Man, "it is the glory of God to conceal a thing, and the glory of man to find it out" (§ 892, *b*, 905¾).—NOTES K L pp. 1119, 1120.

905, *a*. I will now present a comprehensive example which illustrates the foregoing doctrines. A seton, passed through the skin of the neck, removes inflammation of the eyes. In this instance, nothing can possibly enter the circulation, but the whole influence of the seton upon the eyes must be exerted through reflex actions of the nervous system. By tracing out all the effects of which this seton is capable we may show that it involves all the principles which are concerned in the production of disease and its cure (§ 63–81).

In the first place, the seton establishes an inflammation in the part of the skin in which it is inserted. Here we have the whole interpretation of morbific agents in producing their direct diseases. Like the seton, all others act upon the irritability of parts, directly or by reflex action, alter its nature, and involve the other organic properties in corresponding changes, when a change of function ensues as a consequence; and then may follow a variety of physical results.

Now let us consider the seton in its curative aspect, as it relates to the ophthalmic inflammation. The morbid state of the skin operates as a peculiar stimulus, the result of which is transmitted to centers of the nervous system, where it develops and modifies the nervous power, and reflects it through organic nerves (§ 893 *a*).* The intensity of the nervous power, thus developed, is not sufficient to alter the organic properties of any part excepting the susceptible ones which conduct the inflammatory affection of the eyes through their instruments of action, and therefore no sympathetic disease is produced. But irritability being preternaturally susceptible in the inflamed eyes, the nervous power operates with effect upon it, and alters the nature of that and other properties so as to enable them to return to their natural state; and thus the inflammation subsides (§ 150, 151, 854).

We will next see how this seton may become the cause of disease in other parts by reflex action, and we shall then, also, have the whole of the principle which is ever concerned in the development of secondary diseases; and we shall see, too, that the principle is precisely the same as that which concerns the curative effects of remedies when they operate upon remote parts through the medium of another part; as in the curative effect of the seton upon the inflamed eyes.

Let us, then, suppose that the seton is permitted to remain in the neck after it has accomplished the cure of the eyes, till, finally, it ex-

* In this *curative* effect, as in the case of vesicants (§ 893 *c*), centres of the sympathetic nerve are more interested than the cerebro-spinal axis.—NOTE DD p. 1132.

cites a severe degree of inflammation in the surrounding skin. By-and-by, we find the patient beginning to lose his appetite, the tongue coats up, and other marks of a diseased state of the stomach set in. This organ, therefore, has become involved in disease in consequence of the neglected and irritative state of the seton. Still, however, the mischief is allowed to go on, and the eyes, which had been relieved by the seton, again become inflamed. The seton has been the essential cause of this round of phenomena; and since nothing can have been introduced into the circulation, from beginning to end, we must look to the nervous influence for the remote developments of disease, as in the former case for the curative results (§ 514, *h*). The seton, after the cure of the eyes, had taken on a higher and modified state of inflammatory action, and it transmitted to the brain and spinal cord such influences as developed the nervous power in greater intensity and a more morbific condition. This state of the nervous power, being reflected abroad, fell with greater force upon the stomach than on other parts, from its peculiar susceptibilities, and its close natural relations with the skin and cerebral system (§ 233¾). The stomach has also the eyes much under its control, and the eyes are now particularly liable to be injuriously affected by reflex actions instituted by the stomach on account of their recent inflammation, which left them in a more than usually susceptible state. The stomach, therefore, in transmitting its morbid impressions to the cerebro-spinal axis, co-operates with those from the seton in increasing and reflecting a morbific nervous influence upon the eyes. Thus, like vesicants, setons are mobific when their action extends beyond the centres of the organic nerve (§ 893 *c*).

We have now to consider the natural tendency of the properties and actions of life to return from diseased to their healthy states. The seton, as we have seen, is the sole cause of the new developments of disease in the stomach and eyes, and these effects are maintained by keeping up the irritative inflammation of the skin. If, therefore, we withdraw the mechanical irritant from the skin, the inflammation of the part will subside spontaneously; and having thus removed the exciting cause of disease in the stomach and eyes, these parts, also, return spontaneously to their healthy states. Thus it is, also, that the irritation of setons, issues, blisters, &c., when applied over the joints, &c., for the removal of inflammation of the ligaments or other tissues, may, after having greatly fulfilled their purpose, ultimately keep up a degree of the disease, or increase its intensity. But, if the skin be now healed, the disease will subside spontaneously,—the very healing of the skin reflecting salutary influences. This is often verified by the effects of remedies when administered internally; disease being ultimately aggravated by the means which were at first curative, but again yielding with rapidity as soon as the remedy is discontinued. In all the cases, the ultimate subsidence of the aggravated conditions of disease is owing to the artificial modifications of their pathological cause. This recuperative law lies at the foundation of therapeutics, and it shows us that the first and greatest step in the treatment of diseases is to remove their exciting causes; when the natural physiological constitution may require no other aid from art (§ 853).

The only remaining consideration to complete the essential philosophy of the operation of remedial and morbific agents relates to the direct action of remedies in curing diseases of parts to which they

may be applied. If an emollient poultice, as it is called, or opium, or leeches, &c., be applied to the inflamed skin, they may hasten the subsidence of the inflammation. This is done by their direct alterative action upon the diseased properties of the part, as in the case of morbific agents; and in proportion to the subsidence of the primary affection may be that of the sympathetic diseases. But, the sympathetic affections may be also hastened in their decline by the direct application of remedies to the sympathizing parts; or, we may contribute to the cure of the whole by addressing remedies directly to one of the organs which has been sympathetically involved, as to the stomach in the foregoing case; or, the sympathetic affections may go on independently of the cure of the primary disease, and require a distinct treatment; or, it may be necessary to cure them first, before the primary disease can be removed. The diseased state of the stomach, for example, in the foregoing case, may, in its turn, establish a morbific reflex nervous action upon the seton, and thus complicate the principle as to exciting causes, and institute a mixed condition of reflex nervous influences. This, in fact, is more or less the case, in most diseases, after the morbid state is propagated from the primary seat. In the example now stated all the diseased parts act and react upon each other, each becoming a point of departure for the development of a morbific nervous influence, and each affection, therefore, contributing to maintain and aggravate the others. Other organs join in, though perhaps not essentially disturbed, and take their part in the disease according to their degrees of affection, and more or less, also, according to their relative vital importance and constitutional relations; while the great movement of diseased action may be variously influenced by the contingencies which grow out of constitution, temperament, age, habits, external influences, &c. (§ 512, &c.).

And so, on the other hand, when the curative process begins, whether instituted by nature or by art, the whole organic system may concur in the salutary change which is started at a single point (§ 143, *c, and references there*). It is all the work of the physiological laws.

905, *b*. The vast advantages which are every where arising from warm poultices, and warm fomentations, both in the hands of the physician and the surgeon, lead me to advert still farther to the philosophy which concerns their effects, in the hope that it may not only tend to their more frequent substitution for powerful agents, or for the surgeon's knife, and, therefore, to a better appreciation of the recuperative law, and a greater reliance upon Nature herself, but that it may contribute light upon the fundamental cause of disease, and the remedial action of all things else.

In what I have hitherto said of the foundation of disease in common physiological principles, and of the near approximation, in their pathological states, of all the varieties and modifications of inflammation, in connection with what has been variously and specifically stated of the common mode of action which obtains with all efficient remedies, from the vesicant to the sedative, it is evident that the remedial action of poultices, and hot fomentations, falls under the universal philosophy. From blisters and irritating cathartics we readily pass along an intermediate series of analogies that are represented by other agents till we arrive at tonics and stimulants. In a former section I was employed in endeavoring to show, through the operation of these last

agents, that there is no ground whatever for the distinction which has been made of inflammation into active and passive, or sthenic and asthenic, conditions (§ 733 *f*, 752–756). The example supplied by erysipelas, in which blisters and leeches may afford relief when applied to the inflamed surface, either separately or conjointly, is only another impressive evidence of the close approximation of the various pathological states of inflammation; and the variety in the remedial virtues of the curative agents which have now passed under review goes to prove that they operate merely by inducing conditions of disease more favorable to the recuperative process. Loss of blood produces one kind of change, cathartics another, tonics another, vesicants another, and so on; but each one induces a change from which the morbid properties are capable of passing to their natural state (§ 892$\frac{3}{4}$, *b*). These principles enable us to understand how a great variety of physical and mental causes will often succeed in removing some particular malady, as one or another may be brought into action at its different pathological phases, as in intermittent fever; and reconcile, also, those embarrassing contrasts which have led to many errors in pathology and therapeutics, as when tonics and stimulants remove inflammation, or when patients equally survive the treatment of gastro-enteritis by capsicum or lobelia, as practiced by the bold and unprincipled empiric. A more violent inflammation may be the temporary consequence; but it differs from the original in being modified by the peculiar morbific virtues of capsicum or lobelia, and in which modifications the diseased properties are sometimes capable of exerting their recuperative energy (§ 1059).—See NOTE EE p. 1133.

This conducts me to a more circumstantial exposition of the remedial action of local sedatives, especially of those for which this section was designed. In the mean time, however, on looking at the group of *local sedatives*, as arranged in my Materia Medica, we find linseed, and bread and milk poultices, holding the very first rank, while sedatives of the most active virtues, such as stramonium, aconite, belladonna, cicuta, cyanide of potassium, morphia, opium, henbane, &c., follow the poultices and hot fomentations as inferior remedies.

But this arrangement, like that of all other groups, is founded upon the supposed relative usefulness of the several agents in fulfilling the objects of each group, respectively. Since, therefore, emollient poultices and warm fomentations effect the greatest amount of relief, and are far more generally applicable in practice than all the rest, as local sedatives, they should hold the first rank in the arrangement, notwithstanding the activity of their virtues is immensely less than that of the other substances which I have mentioned. It is the effect of all, however, to lessen irritability and sensibility, and thereby to moderate or subdue inflammatory action. But many of the local sedatives go farther than this. They also affect irritability and sensibility, especially the former property, in their existing nature or *kind*, and, of course, induce a corresponding change in the *kind* of action. Now, it is this alteration in *kind*, beyond the mere sedative effect, which makes up the differences between the various agents of the group of local sedatives. Poultices and warm fomentations produce the least of this change in kind; their effect scarcely reaching beyond that of reducing an exalted state of irritability and sensibility, or of keeping it down

where it is liable to ensue. The acetate of lead follows next, in this simple but most valuable effect.

The foregoing moderate influences, with little or no specific alteration in *kind* of the morbid properties and actions, is just what is wanted in a vast number and variety of morbid states, as in superficial inflammations, abdominal irritations, sprains, bruises, piles, &c., or as means of prevention in the hands of conservative surgery. There is nothing comparable, for these purposes, with warm poultices and warm fomentations. Their immense services in the healing art, I say again, should turn the attention of physicians and surgeons with increasing reliance upon recuperative Nature. Let us study the precepts as inculcated by the fathers of medicine, an imbodiment of which may be seen in three of the *mottoes* at the head of a former section (§ 894).—Note E p. 1114.

In respect to the poultices, &c., no doubt the moist heat exerts some slight alterative effect beyond that of simply reducing the exalted properties and actions of inflammatory conditions. But, all the other changes and results which take place are brought about by Nature, and not by the poultices (§ 878, 891 *i*, 891½ *g–k*).

If local inflammations, to which poultices and warm fomentations are applicable, have given rise to disturbing reflex actions, or to inflammation of other parts, these sympathetic results may subside spontaneously when the primary disease gives way. But the poultices have nothing farther to do with any of these great movements of Nature than simply to lessen the irritability of the inflamed part with which they are in contact. In conservative surgery, poultices have even less participation in all those terrible compound fractures and dislocations whose cure they enable Nature to conduct with but even little inconvenience to their subjects, and which, till in recent times, were doomed to the amputating knife. In all these cases, the simple agents are only instrumental in keeping down irritability, and thus preventing inflammation and constitutional disturbances. They act partly upon the principle of keeping exciting causes out of the way of Nature (§ 856, *a*).

Finally, a word as to the contribution which is made by these great remedies toward the resolution of those phlegmonous inflammations which are disposed to result in suppuration, or how, in other cases, they promote that disposition.

If the phlegmon have not reached the turning point, as it were, of the inflammatory process, or when the formative is about passing into the suppurative stage, an emollient poultice, by lessening irritability, will be very likely to promote resolution, and thus to prevent the suppurative stage.

But, when suppuration has begun, Nature, herself, has taken on the work of cure, and an abatement of morbid irritability is the first recuperative change in this natural process. Now it is, therefore, that poultices, through their tendency to lessen morbid irritability, co-operate with the natural process, and thus promote suppuration (§ 733, 735 *a*, 862).

GENITO-URINARY AGENTS.

905½, *a*. In consideration of what I have said of *Emmenagogues* (§ 892⅔, *q*), and to illustrate yet farther the action of remedial agents, before entering upon the subject of bloodletting, I have concluded to

set forth the ground of distinction which induced me to assemble into two groups those agents which bear the general denominations, in my Materia Medica, of *Uterine Agents*, and *Genito-Urinary Agents*. By introducing, also, the several members of each group, along with the numerical order of arrangement, it will be farther seen how far the arrangement has been founded upon physiological principles, and how far it is adapted to the modifications which are presented by pathological conditions (§ 137 *d*, 872 *b*, 892⅘ *b*, *c*). There will be thus, also, farther exemplified the relative specific relations of many remedial agents to certain tissues, or parts of a common tissue, and farther, also, by the recurrence of the same agents in different groups, their therapeutical capabilities in their aspect of compound virtues (§ 129, 135, 136, 137 *b*, *c*, 150, 151).

Uterine Agents, *in the order of their value* (*numerically*).—1. *Secale cornutum*. 2. *Oleum ergotæ*. 3. Cantharis vesicatoria. 4. Sanguisuga. 5. Guaiacum officinale. 6. Juniperus sabina. 7. Ferrum, et ferri sales. 8. Aloe socotrina. 9. Balsamodendron myrrha. 10. Hydrargyri sub-murias, etc. 11. Hydrargyri iodidum. 12. Iodinium. 13. Potassii bromidum. 14. Ferri bromidum. 15. Ipomæa purga. 16. Juniperus Virginiana. 17. Aristolochia serpentaria. 18. Ruta graveolens. 19. Ferula asafœtida. 20. Sodæ biboras. 21. Mentha pulegium. 22. Helleborus niger.

Genito-Urinary Agents, *in the order of their value* (*numerically*).—1. Copaifera multijuga. 2. Piper cubeba. 3. Cantharis vesicatoria. 4. Strychnos nux vomica. 5. Barosma crenata. 6. Abies balsamea. 7. Oleum terebinthinæ (pinus et abies). 8. Pistacia terebinthus. 9. Arctostaphylos uva-ursi. 10. Cissampelos pareira. 11. Laurus camphora. 12. Tinctura ferri sesquichloridi. 13. Chenopodium olidum. 14. Chimaphilla umbellata. 15. Cinchona officinalis. 16. Amyris Gileadensis. 17. Pistacia lentiscus. 18. Physalis alkakengi.

905½, *b*. The foregoing assemblages suggest, by the remedial virtues of the several members of each class, respectively, a great variety of pathological conditions relative to the uterus in one case, and, in the same manner, the genito-urinary organs in the other. We have already seen how ergot is mainly useful in parturition; and its obvious effects through reflex nervous action supply a clear analogy for expounding the effects of the other agents (§ 893½). The other members of the Class of Uterine Agents are such as are denominated emmenagogues, with the exception of the fourth. But, leeches should evidently follow cantharides, in the order of importance, as capable of yielding relief, not only in the next greater number of cases, but in very difficult pathological conditions of the uterus; while the high place which they occupy is significant of irritable and inflammatory, or congestive affections of the uterus which may often call upon their aid, and admonishes the practitioner to beware of most of the other agents which follow. It is not, however, to such cases alone that leeches to the perinæum are appropriate, but to many cases where menstruation has been long arrested by slight derangements of the uterus, as sympathetic consequences of gastric or other abdominal derangement, but where the influence of vital habit is such that neither cantharides nor the stimulating emmenagogues, if admissible, will affect the condition of the organ; though its susceptibility to these agents may be established by leeching (§ 137 *d*, 892⅔ *q*, 893 *q*). Should leeching, there-

fore, fail, it is appropriate that an emmenagogue which may now succeed, and often by itself, should stand next in the order of arrangement; and of these, guaiacum is the best.

It need scarcely be said, that in the reference which I have made to emmenagogues in section 892⅔, *q*, I embrace alone those which have been hitherto grouped together with a special reference to *the symptom*, and upon which the denomination has been founded (Ἐν in, μην, month, and ἀγω, to lead).

We soon come upon the ferruginous preparations, and these, again, are significant that the uterine embarrassment often grows out of indigestion, or, less frequently, that some primary affection of the uterus has been the sympathetic cause of a gastric derangement that reacts upon the uterus and maintains its pathological condition (§ 902 *b*, 905 *a*). But, it does not often happen in primary uterine affections that an appropriate treatment will not readily succeed; especially leeches if inflammatory, or, otherwise, cantharides, and the subordinate means. Such, however, is the disposition of the system, especially of the digestive organs, to sympathize with inflammatory, or irritable states of the uterus, that these cases soon become complicated, and we may then turn to the example of the seton for the principles of treatment, nor waste our efforts at unavailing attempts with emmenagogues addressed to *the symptom*, but let them be such as shall meet the uterine complications.

Where ferruginous agents are proper, so, also, in a general sense, is guaiacum, or some analogous means. But, the attendant gastric derangement is apt to be accompanied by constipation, which is more or less dependent on an associated functional derangement of the liver (§ 129). Aloes, therefore, properly follows next in the order; and, although it may affect rather specifically the mucous tissue of the uterus, urinary organs, and lungs, in its irritable states by reflex nervous influences, it acts as an emmenagogue mostly by contributing relief to hepatic disorder, augmenting the natural stimulus of the intestine, and, in other ways, removing constipation, and thus, also, *the symptom* (§ 889 *i*, 889 *l*, 902 *b*, 1063 *b*).

The simple mercurial preparations, which follow as the tenth in order, equally admonish us, also, to keep our attention upon the pathological condition, and away from *the symptom*, excepting as it is very vaguely significant of some morbid state of the uterus which can be known only through other phenomena. The rank of this agent implies, also, its degree of utility, the ratio of its frequency in contributing aid, its adaptation to a variety of pathological conditions that may be complicated with the uterine derangement, and the probability that it may be advantageously associated with leeching, and only as a subordinate agent. It comes into use, especially, in inflammatory states of the uterus, or when hepatic derangement takes the lead, and is inobedient to milder treatment.

The next are the iodides of mercury, and the bromides of mercury are about the same; and, who does not see that their special reference is not to the uterus, but to some other visceral derangement; perhaps of a syphilitic, or scrofulous nature, or under those diatheses? But which, and how much, what the pathological shades, what the exact condition of the uterus, how far it receives and reflects sympathetic influences, are matters for critical inquiry (§ 894 *b*, 901, 902 *b*)

The union of mercury with iodine also suggests a general antiphlogistic treatment, and that, like the more simple mercurials, it may be often associated with leeching.

Iodine or the bromide of potassium is wanted next, on account of the scrofulous diathesis, or other special conditions to which those remedies are adapted. It denotes that the uterine function is often suspended by chronic visceral disease which has gone on to disorganization, especially of the liver or spleen; though, in other cases, it supposes the same condition of the uterus as a primary affection (§ 892½). It may be only the indigestion so often incident to the scrofulous constitution which arrests menstruation, and often without much derangement of the uterine system; and here iodine contributes an important aid. The uterus surrenders as soon as the morbific reflex nervous actions are withdrawn. The bromide of iron may be often now called in advantageously (§ 150, 151, 894 *b*, 901, 902 *b*).

Jalap is wanted to carry out a decisive antiphlogistic treatment, which is occasionally demanded; sometimes for primary inflammation of the uterus, or again for some general plethoric habit, or some obstinate chronic gastritis, and where the functional derangement of the uterus is of very little importance. In many of these cases, general bloodletting should take the lead in the treatment; and the menses may start under the beginning impression of the remedy (§ 872 *b*, 892¾ *b*, *c*, 1060).

But, there are no cases which so constantly baffle the practitioner as those which are presented by the nervous temperament; and these are common (§ 601). A reference to the characteristics of that temperament will show us, at once, how it has happened that asafœtida is the only agent that has been introduced with a specific reference to *the symptom* in this class of remedies. The whole body is so alive to reflex nervous actions, as disease may touch upon one part or another, and more profoundly as it may plant itself in greater force, that nothing can be now accomplished but through the precepts of the most enlightened medical philosophy. It is here, too, that we see most distinctly pronounced the complete possession which gastric derangements may take of the uterus, and overthrow its function, or where it may be interrupted by a sudden reduction of the temperature of the feet, or by a midnight frolic, or by drawing the habitual corset a little tighter. Now, too, any disturbance of the uterus, whether primary or secondary, reacts on most other parts, while they, in their turn, resent, as it were, the injury (§ 514, *h*, &c.). The treatment of these cases, therefore, may be as complex as the morbid sympathies. But, in a general sense, the best and often the only requisite emmenagogue will consist of a carefully-regulated diet, early sleep, free exposure to the open air, accompanied with a suitable kind of exercise, sometimes shower bathing, or, at other times warm bathing, removal of corporeal restraints, cheerfulness of mind, and a little rhubarb and magnesia to improve digestion, keep down acidity, and to help any sluggish state of the bowels. We must repair the constitution of theso patients; and there will then be no difficulty with *the symptom*. It has been a neglect of the means, the neglect of pathology, and the *name* of emmenagogue, which have led to most of the failures of art, and have contributed to swell the nomenclature of "nervous diseases" (§ 659, 855, 856, 878, 902 *m*). Nor has the fashion of "*Specialities*,"

which forms one of the perversions of morbid anatomy, as handed over from France, and one of the roads to distinction and practice, been wanting in a liberal contribution to the very errors which it professes to reform. The principal observers are generally able, always industrious; and would they but merge their tangible, isolated objects in the comprehensive philosophy of medicine, they would give an impulse to science, and a direction to practice, which would bring honor to themselves, and bestow a service on mankind. We need no better demonstration of this than what I have just been saying of the nervous temperament (§ 701, 960 *c*).

905½, *c*. We come, next, to the *Genito-Urinary Agents*, where a great variety of remedial virtues occurs, but, unlike the case of emmenagogues, where all have a special reference to the genito-urinary system, with the uterus excepted as to its relations to cantharides and chenopodium. It is a group, therefore, which illustrates, throughout, what is denominated specific action, and exemplifies extensively the special modifications of irritability in different parts of the body (§ 133, &c., 150, 191).

When, therefore, these agents are employed with reference to the genito-urinary system their local action is alone contemplated. The favorable changes which they induce are of a direct nature as it respects that system of organs; and they do not, therefore, contribute relief by effecting the removal of diseases situated remotely from those parts (§ 905½, *b*).

Hence, it is readily seen how liable to misapplication such a group of agents must necessarily be without a sound knowledge of physiology, and an enlightened view not only of the general conditions of disease, but of the pathological varieties and shades of difference which are constantly presented by any given common form of disease; especially of inflammation (§ 639 *a*, *b*, 650, 662, 669, 671–674, 718, 722, 819 *a*, *motto*, no. 7). To such an observer the assemblages in the various groups are peculiarly valuable, and for such, indeed, are they alone designed. To him, each group, each remedy, every virtue in a compound remedy, and whether so by Nature or by art, has its individuality, which is recognized as the eye glances from one agent to another, while it carries along an associated recognition of a vast variety of pathological states, and a just appreciation of the relative therapeutical value of the various means which may be the subjects of his transient inquiry. But, the group now under consideration being exclusive, and, withal, not as liable to morbific effects as are most other classes, the uninformed has less chance at mischief than when he approaches the cathartics, &c.; where physiological and pathological knowledge is far more important.

It is readily seen, therefore, that one, or more, of the foregoing agents may be exactly adapted to a given modification of disease, inflammation, for example, affecting either the mucous tissue of the vagina, or of the bladder, or of the urethra, while it would be very unsuited to another modification; and, from what we have seen of the natural modifications of the vital constitution in the same tissue as it may occur in different compound organs, and in different parts of a continuous tissue as it traverses different organs (§ 134–137), it is evident that great circumspection is often necessary in the application of these agents; and farther, also, that what may be immediately useful

in some special state of inflammation as affecting one of the several parts of the genito-urinary mucous tissue may be detrimental in an apparently coincident form of the same disease in either of the other parts; and vice versa (§ 137 *c*, 150, 151, 870 *aa*). Here we have, for example, amenorrhœa, as considered in the foregoing section, depending on active inflammation of the uterus where general bloodletting may be demanded, and may be sufficient; but, in event of its failure to establish menstruation, cantharides, which would have been otherwise pernicious, may now complete the requisite instrumentality of art (§ 137 *d*, *e*, 143 *c*, 859 *b*, 863 *d*, 867, 871, 905½ *b*.)

Take, next, the same agent as the best internal remedy for leucorrhœa. Here, again, the inflammatory states, which constitute that affection, vary constantly, not only as to force and habit (§ 535, &c.), but more greatly in the absolute modifications of inflammatory action. For all this knowledge we must go to our general principles, then to all the minutiæ of symptoms (§ 685, 686). Among the last none are so important as the exact character of the discharge, which varies, by gradations, from purulent to mucous, and from this last to a bloody, or a brown watery, or a more simple watery fluid; just as we have seen of analogous phases in the condition of ulcers, or of intestinal inflammation (§ 693, 740). Now, it is clearly wrong to treat any one of these several conditions exactly in the same manner; and where the differences are broadest, so also must be the variations of treatment. In indolent states of the disease, and where the discharge is mostly purulent, if the general health be tolerably sound, we may proceed, at once, to the exhibition of cantharides; and, as soon as slight strangury takes place the disease will generally surrender. But, should it, in the cases supposed, refuse to submit, or should the individual be insusceptible of the special action of cantharides, as will commonly be denoted by the failure of its effect upon the bladder, we may safely, and commonly with certainty of success, resort to vaginal injections of the best nitrate of silver, in proportions varying from three to eight grains in an ounce of water. But, if the discharge consist of mucus, or any other than the puriform matter, cantharides will aggravate the affection, and the nitrate of silver, at most, will do no good. If it be mucus, it denotes an intensity of inflammation which calls, at least, for a simple vegetable diet, and probably for leeches to the perinæum, along with the general antiphlogistic treatment. In these cases, therefore, we have nothing to do with the genito-urinary agents. Equally inapplicable, also, are they to those pathological states from which result the watery discharges; and here we are completely thrown upon the special circumstances of every individual case, and upon the general principles of the science.

This last remark leads me to another more important than the rest; namely that all the pathological varieties which go to constitute *the symptom* may be variously complicated with morbid affections of other important organs, especially those of the abdomen, through alterative influences of reflex action of the nervous system. This, indeed, is always the case in the watery discharges, almost always in the mucous, and very often in the puriform. In all the cases, too, the vaginal or uterine affection may be entirely a sympathetic result of primary disease in the digestive organs; and such is usually the case where the discharge is of a watery nature. We may be sure, however, that

the sympathetic affection will react upon the system at large, especially in the more intense form which is denoted by the mucous product; and this, whether the genital affection be primary or secondary.

Here, then, we must apply ourselves to the general health, attack what may be the citadel of disease; but, to do this efficiently, and that our prescriptions may carry with them the combined virtues of *tuto, cito, et jucunde*, the practitioner may not undervalue the Institutes of Medicine.

Whenever the uterus is the seat of disease in its mucous tissue, like all other organs which may be especially affected in one of its parts, the other component parts suffer, more or less, sympathetically (§ 138, 141 *b*, 514 *f*, 528).

A common form of discharge takes place from the uterus which is more or less of the nature of lymph. Here there is pretty high inflammation, as well as obstinate. It calls, of course, for general bloodletting, leeching, &c. I say nothing of cases requiring local remedies.

Copaiva is the first among the agents in the group before us. This denotes the frequency with which it is called into use in the treatment of gonorrhœa, and its relative value for this specific purpose. Cubebs follows next; and as two agents of similar virtues in relation to a specific object, and of nearly equal pretensions, and both of them stimulant, lead off in a general class of remedies, they are, by the position they occupy, standing mementoes of the frailty and vulnerability of man, and incentives to study well the varying conditions of gonorrhœa. Here we have rarely more than a local complaint for our professional skill; and yet, how much suffering is inflicted, how many made wretched in their domestic relations, by the indiscreet use of these two valuable agents, and by astringent injections! The haste of the patient may be always moderated, or conquered, by firmness in the appropriate means, and the practitioner rewarded in conscience, and thanks, where he may elect, for the preliminary treatment, that antiphlogistic plan which will speedily prepare the way for the remedies of more local action, if it do not in itself succeed. Here, too, we may notice in the contingent circumstance, as in all other groups, that when gonorrhœa yields to general or local bloodletting, or to cathartics, or to water gruel and perfect rest alone, another of the multifarious demonstrations of the common mode of *Remedial Action.*

905$\frac{3}{4}$. In concluding the subject of Remedial Action as hitherto expounded, and before entering upon that of loss of blood, I shall take the liberty of protesting against the unreserved imputation of ignorance as to the *modus medendi* of remedies, and of which I have quoted some examples (§ 904 *e*, &c.). It is true that they who allege this ignorance cultivate the humoral and chemical doctrines, ignore all distinction in the powers by which the two kingdoms are governed, and satirize the laws of the nervous system if supposed to involve any thing more than chemical action. These positions certainly imply, as far as they reach, all the acknowledged ignorance, and the objection, therefore, which I now raise is against the imputation of this ignorance to those who have taken the trouble of informing themselves about the things which they profess to understand. They object to a degradation to such a level. Where the ignorance exists its confession is laudable and useful.

THE INFLUENCES AND MODUS OPERANDI OF LOSS OF BLOOD,

Considered with a Reference to the practical Application of the Remedy and the various Circumstances of Disease.

906, *a*. "The serous portion of the blood, or even pure blood, may escape from the over-distended vessels, *just as water transudes through the permeable sides of a vessel, in which it suffers compression.* To this source are to be referred several hemorrhages and dropsies produced by simple transudation in a tissue *mechanically congested*; and although these affections have really *nothing active* in their nature, yet are they considerably diminished, and sometimes altogether removed, by bloodletting, which, in such cases, acts in a manner *purely mechanical*, by removing from the vessels the fluid by which their parietes were kept in a state of over-distention."—ANDRAL's *Pathological Anatomy.*

b. "If bloodletting be considered in a *mechanical* light, as simply lessening the quantity of blood, I cannot account for its effects; because the removal of any natural mechanical power can never remove a cause which neither took its rise from, nor is supported by it."—HUNTER *on the Blood and Inflammation.*

c. "It is a *great modern improvement* in the practice of the healing art, in bleeding for the cure of inflammation, to take the blood away as *quickly as possible*; since intense inflammations of the brain, lungs, bowels, &c., *are equally removed* by faintness, whether it happens after the loss of ten ounces of blood, or of fifty; or even, as sometimes occurs, when it happens without bleeding at all, after merely tying the arm in preparation."—ARNOTT's *Elements of Physics.*

d. "If we have to deal with an extensive and violent inflammation, we do not abstract blood by a minute opening; we make a large orifice, or we open a vein in both arms at the same time; we place the patient in an erect posture, and endeavor to produce deliquum. It sometimes happens that the patient *faints from fear*, or before any considerable quantity has been lost; and *this faintness*, as Dr. Arnott remarks, *answers as well* as that which results from venesection" (§ 960, *a*).—GRAVES, *in London Med. and Surg. Journal*, vol. iii., p. 391.

e. *Ad extremos morbos extrema remedia exquisite optima.*"—HIPPOCRATES (§ 960 *h*).

906, *f*. WHETHER the father of medicine, or his latest descendants, be right or wrong in their medical precepts, especially in relation to the therapeutical uses of bloodletting, it will be an object of the present inquiry to ascertain (§ 376¾, *a*). The contrast of views, especially when we consider the details inculcated by Hippocrates in respect to loss of blood, as well as other remedies, suiting them all to the exigencies of disease, or leaving the whole work to Nature, and, with all his enlightened precaution, regarding the loss of blood as the *remedium principale*, renders it, I say, an object of deep interest to determine the nature of the right, and, in so doing, to ascertain also how far philosophy and practical habits have outstripped the Ancestor.

We may also, perhaps, come to some determination whether a knowledge of the principles upon which bloodletting operates be worthless, or necessary to its just and intelligible use (§ 893, *n*). Whether we should know what absolute influences it exerts, or how it exerts them, before we can appreciate its applicability, and its appropriate extent, in many important morbid states where the remedy may be more demanded than in other conditions whose phenomena clearly indicate its necessity (§ 857).

Perhaps, also, it may be useful to science, as well as humanity, to strip this remedy of its mechanical interpretations, and to place it upon the dignified, practical ground of the physiological institutions of organic Nature, which, if unacceptable to the materialist, will, at least, engage his attention as a philosopher.

906, *g*. Before entering upon the investigation of this subject I take leave to say, that the modus operandi of loss of blood, as set forth

in this work, is exclusively original with myself. If there be any merit in the philosophy, its abuse and misrepresentation by the *British and Foreign Medical Review*, and the *Medico-Chirurgical Review*, of London, entitle me fully to all the proprietorship. Whatever is said of the vital influences of the loss, and of the whole theory of the associate influence of the nervous power, appeared for the first time in the Medical and Physiological Commentaries (§ 222, *b*). Copyists, it is true, have appeared, especially of the accumulated facts, without the slightest reference to him who performed the labor (§ 435, *b*).

Although, therefore, the same philosophy, and the same practical applications of loss of blood, are preserved in the Institutes as set forth in the Commentaries, they are now rewritten and presented in another shape, with greater brevity, and with reference to that systematic order which shall best subserve the young Inquirer. The same is also true of other subjects which may have been investigated in the Commentaries.—See RIGHTS OF AUTHORS, p. 912.*—NOTE W p. 1127.

907. Notwithstanding the practical importance of a distinct apprehension of the modus operandi of loss of blood, it should never be the leading indication for its use; but only subservient to the suggestions of the morbid phenomena, of pathological principles, and of experience. The just application of the remedy should be determined by these combined considerations (500 *m*, 688, 694¾, 826 *cc*, NOTE LL).

908. Again, by taking a comprehensive view of the direct influences of loss of blood, we shall not fail to discover the close analogy of its modus operandi with that of all other remedies, and that it reflects an important light upon the whole ground of remedial action; while its loss involves in its effects some principles peculiar to itself.

909. The hypotheses which have hitherto prevailed respecting the operation of loss of blood have been, for the most part, mechanical; but I have demonstrated in my Essay on the Philosophy of its Operation, that the effects of blood-letting are wholly incapable of such explanation. Nevertheless, even dry cupping, and ligatures to the limbs as extensively inculcated by Erasistratus and facetiously commemorated by Galen, are again restored as substitutes for loss of blood (§ 1004 *c*).

910. The numerous advocates of the mechanical doctrine of inflammation and venous congestion predicate their views of the operation of bloodletting in conformity with the supposed existence of passive relaxation of the affected vessels, and stagnation of blood within them, and extend the hypothesis to the hot stage of idiopathic fever. The philosophy, therefore, is vitiated by the pathological views upon which it is founded. Moreover, were the doctrine of debility (§ 569), passive relaxation of the vessels, and stagnation of blood, correct, it is evident that not only such relaxation, but that the stagnated and coagulated blood, would not be suddenly removed by diminishing, to any extent, the general circulating mass, as is constantly witnessed in inflamed parts; while, also, were such a physical impossibility within the power of the remedy, those vessels would immediately become again congested, and the more so from the prostrating nature of the remedy (§ 935, 977).—NOTE DD p. 1132.

911. General bloodletting, cupping, and leeching, manifest some important differences in their effects, but operate upon modifications of a common principle. A knowledge of these modifications is necessary to a right administration of the remedy as it respects one ci

* The Works of Authors quoted in this Essay may be found in the "Commentaries.

the other modes of abstracting blood. Neither method has been founded upon any rational principle.

912. How, then, does bloodletting operate? How are diseased parts immediately and permanently unloaded of their blood, in some instances by the abstraction of two or four ounces of blood, when, in other cases, under apparently the same circumstances, a great extent only of the remedy will effect the same result? Why, in such cases, may the former quantity induce syncope, when the latter has no such effect? "Syncope," says Robert Jackson, "occurs sometimes in yellow fever from the loss of a few ounces of blood, sometimes scarcely from the loss of six pounds." Why does this coincidence obtain with so many other remedial agents? Why do we see the redness of an inflamed eye give way permanently while the blood is flowing from the arm, and why does the same change take place as rapidly, and even more perfectly, in any of the great organs when equally inflamed and loaded with blood? Why may the action of the heart be weakened by small quantities of blood taken by leeches, when larger quantities would be required to produce a similar effect by venesection (§ 516 *d*, no. 6, 557, 686 *b*, 756 *a*, 775, 889 *l*, 893 *a*, *c*, 900, 904 *c*, 921, 1059)?

Now it is obvious that the foregoing results can be explained only upon the physiological principles which I am about to set forth; while there is not one phenomenon attending all the diversified effects of loss of blood that is not susceptible of a clear interpretation upon those principles—an interpretation, too, which corresponds with all that I have said of the modus operandi of every other remedial and morbific agent—nay, even with the natural stimuli of life.

913. The inquiry now proposed will extend from the beginning of the physiological influences, through their gradations, to their consummation in syncope. It will be also accompanied by practical illustrations, and by exemplifications of the various conditions of disease to which the remedy may be appropriate.

1. LEECHING.

914. It will be most useful, in the first instance, to observe the phenomena, and deduce the principles, which attend the direct abstraction of blood from those extreme capillary vessels which are the instruments of all morbid processes. Leeching, therefore, is first in order; the physiological effects of which may be divided into seven stages. Observe, also, that the vessels are *torn* not *cut* as in cupping.

915. 1st. The earlist effect of loss of blood consists in a contraction of the blood-vessels. This is universally true of all modes of abstracting blood (§ 944 *c*).

In leeching, an impression is first exerted upon the organic properties of the extreme and capillary vessels of the part by the direct abstraction of their natural stimulus, the *pabulum vitæ*, as also by the long-continued suction of the leeches, and by the subsequent effusion of blood. These causes institute a change in the vital state of the vessels (§ 189, 498, 930, 944 *c*).

916. 2d. A vital contraction follows immediately, as the consequence, in the extreme and capillary vessels of the part to which leeches are applied. The removal of their natural stimulus is necessarily felt by the highly-susceptible organic properties of the small vessels (§ 188, 189, 191, 410, 411, 746 *c*, 931, 935 *b*, 1040).

917. 3d. Then follows, by continuous sympathy and reflex nervous action, a propagation of the foregoing changes to the entire system of extreme and capillary vessels throughout the body. This arises from the capillary series possessing, every where, an organization and function of a common nature, and from their exquisite sensitiveness to the nervous power (§ 129 *d*, *e*, 141, 222–232, 482, 525, 526 *a*, 935 *b*).

918. 4th. The larger vessels, sooner or later, participate, sympathetically, in the contraction. This sympathy, however, begins as soon, at least, as the general capillary system feels the foregoing influences (§ 944 *c*).

919. 5th. A partial reflex nervous action begins upon the heart as soon as the changes have somewhat advanced in the capillary vessels to which the leeches are applied, and a rapidly-increased amount of this cardiac influence ensues as soon as the whole capillary system is involved in the contractions which the leeches institute at the place of their application (§ 498 *f*, *g*, 524 *a*).*

The effect, as expressed in section 917, is originally propagated along the extreme vessels by continuous sympathy, but reflex action is soon brought into operation, when both denominations concur together; but it is chiefly by reflex nervous action that the heart is influenced (§ 933. For *continuous* sympathy see § 129 *c*, *f*, 498, 746 *c*, and INDEX II).

920. 6th. Such are the simple elements of the processes which take place in leeching. But, during their progress they become more or less compounded. The reflex nervous influence which is propagated from the extreme to the larger vessels reacts from the latter upon the former, and this reacting sympathy increases the contraction of the small vessels. So, also, as soon as the vital changes in the extreme vessels throw their reflex nervous influence over the heart the changes which take place in this organ reflect back a sympathetic influence upon the extreme and capillary vessels, by which their power over the heart and larger vessels becomes multiplied (§ 514 *h*, &c., 526 *a*, 934).

This complex circle of reflex nervous actions continues to advance till the heart becomes overpowered in its action, and syncope takes place (§ 222–233⅔, 498–514, 893 *a*, *c*, 894–905, 1039).

921, *a*. 7th. An artificial change being instituted in the extreme vessels to which leeches are applied, where the organic properties are most strongly pronounced, and that change being more or less permanent, it continues to excite a powerful reflex nervous action upon the whole capillary system, and thence upon the heart, long after the blood has ceased flowing (§ 514 *g*, &c., 516 *d*, no. 6, 939).

921, *b*. It is for this reason (no. 7), and this only that the powers of the general circulation may be sometimes more prostrated, and be longer maintained in a state of prostration, by the loss of four ounces of blood by leeching than they might have been by the abstraction of sixteen ounces of blood from a large vein, or by eight ounces taken by the process of cupping (§ 514 *g*, 930, 939 *f*, 944 *c*).*

921, *c*. For the same reason, also, syncope sometimes comes on only many hours after the discharge of blood has ceased. Stimulants, too, may but slowly rouse the general circulation, because the prostrating influence of the artificial change in the extreme vessels cannot be as soon overcome as when syncope is produced by general bloodletting, where no such specific impressions are made (§ 514 *g*, 516 *d*, no. 6), and therefore no persisting reflex nervous influence.

* See sensitiveness of the heart to the nervous influence at § 500 *m*, 826 *cc*, 829.

922, *a*. It is owing to the peculiar nature of the change established in the vital condition of the *lacerated* vessels, by leeching, that the blood continues to flow out for many hours. The process thus instituted must be somewhat analogous to that of secretion, and clearly allied to the hemorrhagic action which nature institutes, though generally more prostrating than the natural process.

922, *b*. There is, however, a remarkable difference between the direct effects of leeching and spontaneous hemorrhage, in respect to their force; the former subduing inflammation and congestions more fully and speedily than the latter. It is rare that an equal quantity of blood spontaneously effused impresses the system with a force equal to that from leeching; while large capillary hemorrhages are daily occurring without very sensibly reducing the animal or organic powers, and where, too, the quantity of blood effused is so prodigiously great that it cannot be safely imitated by art under the same circumstances of disease. The nervous power is differently developed.

Although, therefore, in these cases, nature institutes a change strikingly analogous to that of leeching, it is not of the same specific nature. In spontaneous hemorrhage, too, nature sets up, for her own safety as it were, a special modification of action in the system at large that shall sustain its powers under the enormous losses of blood which are often necessary, by the natural process, to the cure of inflammatory and congestive diseases (§ 136 *c*, 150–152, 524 *a*, *d*, 890 *e*).*

923, *a*. Besides the foregoing play of vascular sympathies, a strong impression may be propagated by the whole organ to which leeches are applied to another organ with which it has strong natural sympathetic relations. In low inflammations and venous congestions of the liver, four ounces of blood taken from the verge of the anus by means of leeches may break up those obstinate hepatic affections, when twice as much from the skin over the region of that organ may produce far less effect. Here the specific impression is propagated, in part, along the mucous tract of the intestines, in the manner expressed in sections 498, *f*, *g*; and this *continuous* sympathy gives rise to alterative *reflex* nervous action, the former of which is my continuous influence (§ 498 *a*).

923, *b*. But, again, it is true in a more limited sense, that the influence of leeching may be propagated along the large blood-vessels to the parts in the vicinity where there is a direct vascular communication; though even in these cases, the impression is extended more through the sympathies which bind together the extreme vessels, and the nervous communication of the parts (§ 526, *a*). Comparatively little seems to be due to the imputed derivation of blood. Thence, upon our principles, appears the reason why, according to Dr. Wardrop, "in diseases of the head, as well as in diseases of the eye, more particularly those affecting the internal parts of the globe, leeches applied to the frontal vessels give much more relief than is obtained by abstracting an equal quantity of blood from the temporal vessels by leeches applied to the temples." He also states that a like advantage will be obtained, in cerebral affections, by applying leeches to the lining membrane of the nose, or behind the ears. He thinks the effect greater than when applied to other parts.—Note Dd p. 1132.

923, *c*. In all the cases, however, the effects appear to be mainly produced through the agencies which I have stated. Whenever I have applied leeches to the nasal septum abdominal disease attended the

* Notes Ff p. 1135, Gg p. 1138, Ii p. 1139.

head-affections. The leeches have sometimes relieved the headache, when general bloodletting, cathartics, &c., had failed, while the gastric derangement had also persisted. But, simultaneously with the relief of the head the secretions from the bowels improved, the tongue cleared up, and the stomach and other abdominal organs were relieved. It would appear, therefore, that, as in the case of leeches to the verge of the anus under similar circumstances, the specific impression of leeching the nasal septum is propagated continuously and by reflex nervous action, by the instrumentality of the mucous membrane, to the viscera of the abdomen, and that the head is as well relieved by thus removing this source of morbid sympathies, as by the more direct impression (§ 524 *a*, no. 2).—NOTE U p. 1126.

923, *d*. Hence it follows, as shown also by experience, that leeching will generally exert the greatest effect upon diseased organs when applied to some part with which the organ affected may have strong physiological relations (§ 129, 139, 140). For this reason, and for the advantage of continuous sympathy, leeches should be applied to the anus in muco-intestinal inflammation; but, to the cutaneous region when inflammation affects the peritoneal coat of the intestines or abdomen. There are greater natural sympathies between the skin and peritoneum than between the mucous membrane and the peritoneal. Where no remarkable relations subsist among organs the leeches should then be applied near the vicinity of the part affected, as when the pleura, or parenchyma of the lungs, or the joints, are the seats of inflammation. In such cases we obtain the advantage of local reflex actions as in the case of blisters, &c. (§ 497, 891½ *g–k*, 893 *a*, *c*, *f*).

924. And now a word more as to the doctrine of *Revulsion*, or that, for example, which supposes that when leeches are applied to the feet for the relief of cerebral disease the effect depends upon the diversion of blood from the head toward the feet. And so of cathartics in their action upon the intestinal canal, and of blisters by diverting the blood to the skin, &c. (§ 893, *n*). Nothing can be more unfounded. But, do not leeches, when applied to the feet, exert a greater influence upon diseased conditions of the uterus than upon any other part? They probably do; and it is a forcible illustration of remote sympathy, and coincident with that which is supplied by the suspension of the catamenia from exposure of the soles of the feet to cold, or by the production of catarrh when a current of cold air from a key-hole impinges upon the neck. Just so, if the female now plunge her feet into warm water, or apply leeches upon or near the soles of the feet, the catamenia may be restored. So, too, in relation to cerebral affections, who does not know that a natural sympathy subsists between the feet and the head? "In affections of the head and thoracic viscera," says Dr. Wardrop, "I have, in many instances, recommended patients to apply leeches on the head, chest, and on the feet, alternately; and *almost universally*, I may venture to say, a decided preference has been given to the *feet*."* The philosophy is the same in all the cases, and revulsion is reflex nervous action. Dr. Wardrop, however, had already preferred the application of leeches to the nasal septum, or to the temples, in affections of the head; though his observations as to the feet are also founded on sound experience. As to leeching in amenorrhœa, the remedy has the greatest effect when applied to the perinæum, or to the upper part of the thighs.—NOTE DD

* It is well illustrated by Brown-Séquard's exper. of producing epileptiform convulsions as in § 1037 *a*

925, *a*. What has been now said of disease supposes that leeches are applied under circumstances favorable to their effect. Before this condition can happen, however, in numerous cases where leeching may be ultimately useful, it may be necessary to make a strong impression by general bloodletting; and if two or more general bloodlettings be likely to be wanted, the leeching should be delayed (§ 893 *g–i*, *p*, 927), or until the exciting nervous action is subdued.

925, *b*. Nevertheless, if the chance of leeching alone be taken in these cases, the number of leeches should be very large for adults, that the benefits of general bloodletting may be more or less obtained, through a rapid and copious abstraction of blood. This practice will often succeed in infancy when it will fail at more advanced age; since the loss of blood is more sensibly felt in the former case, and less is required, and the requisite amount is therefore, also, more rapidly abstracted, notwithstanding, too, the ratio of the loss, in proportion to age and size, may be actually greater than in adults. Thus, too, the advantages of general bloodletting are more or less obtained. In similar cases cupping is also more beneficial to children than to adults (§ 576, *e*).

925, *c*. Leeching, or cupping, however, should never supersede general bloodletting in the cerebral inflammations and congestions of infants. In the phlegmatic temperament of adults leeching may answer where it would be inefficient in other temperaments (§ 600). But I speak of these cases rather to illustrate a principle than to raise any doubt as to the propriety of general bloodletting in the grave visceral inflammations of any age after infancy (§ 1009).—Note Ggg.

926. Experience teaches that frequent and small abstractions of blood by means of leeches is often more beneficial in chronic inflammations than a greater quantity at more distant intervals. This corresponds with what I have said of the vital influences of leeching, and of the effect of habit in maintaining disease (§ 549, 560). In these cases, the impression, being frequently repeated, maintains the salutary change which may be produced more perfectly against the morbid influence of habit than greater losses of blood at distant intervals (§ 514 *g*, 535, 540, 542, 548, 549, 557). We see the same principle more frequently exemplified in the effect of blisters upon chronic inflammation; where it is better to apply them frequently, and to a moderate extent, than more rarely and over a larger surface. The philosophy is the same, also, in respect to the relative effects of a large dose of calomel, and that dose divided into four. Analogies likewise subsist between the salutary effects of copious leeching, extensive vesication, and a large dose of calomel, in acute inflammations (§ 559, 893 *h*). And so of numerous other agents. A common philosophy obtains in all the cases, and each example illustrates and confirms the principles on which all other agents operate. And I may here carry the same examples to illustrate the philosophy of the operation of general bloodletting, and the peculiarities which appertain to that mode of abstracting blood; since, as will appear, its influence on the organic properties and functions is more immediately, and may be more profoundly, felt than leeching or other agents; and, being antiphlogistic, it is therefore better adapted to high grades of active inflammation and fever (§ 557). The philosophy of the whole is alone resolvable through reflex actions of the nervous system (§ 893 *h*)

927, *a*. Notwithstanding, therefore, the last proposition in respect to leeching, it often happens that the force of diseased habit is so great as to demand a more decisive and more frequent resort to leeching. It is even not unfrequent that the force of morbid habit attendant on chronic inflammations requires the previous abstraction of blood from a vein, and perhaps repeatedly and largely; not only with a view to the special physiological influences of general bloodletting, but that a large diminution of the general volume of blood may be suddenly effected (§ 925, *a*). The utility and necessity of this practice are frequently seen in the treatment of those chronic inflammations of the mucous tissue of the stomach which follow long-protracted indigestion, and especially if the liver also have become invaded by the same condition of disease. The advantages of general bloodletting in these cases relate as much to the general condition of the system over which a morbific influence has been established as to the seat of inflammation. The general modification exerts a reacting effect upon the part inflamed, and adds to the obstinacy of the diseased habit of the part, and leeching will not reach these influences (§ 143 *c*, 847 *g*). Here it is, particularly, that we witness corresponding, and even more successful, efforts of nature at relief in the torrents of blood that are effused from either the mucous tissue of the stomach or of the lungs; especially the former (§ 890, *e*).

927, *b*. Again, in certain mild, though obstinate cases of purely local inflammations, and before the constitution is brought under the influence of the morbid action; or, in cases where exciting reflex nervous actions have been subdued by general bloodletting, local bleeding by leeches is pre-eminently useful. In either of these cases, general bloodletting continued to a large extent, by the suddenness and violence of its impression, may so disturb the system at large that the inflammation may be kept up by influences produced by this artificial derangement of the whole body (§ 889 *m*, 889 *mm*). But here there is no countervailing action against the effect of leeching; and while the small vessels engaged in the inflammatory process refuse to give way if the disease have been of short duration, there is no danger of establishing any injurious influences upon the general capillary system. This, however, will take place, more or less, when leeching exceeds that degree which is necessary to determine a change in the part inflamed. It may even follow from very copious leeching in severe chronic inflammations, where morbid action is rendered obstinate by the influence of habit, before the diseased process yields. In the former case, the system is injured partly by the influences determined by the excessive change induced in the instruments of morbid action, and, in part, by the general influence from an unnecessary loss of blood. In the latter case, the bad effects appear to be mainly incident upon the loss of blood in its general relation to the system at large. In these cases, therefore, it is important to graduate the extent of leeching by the exigencies and the peculiarities of each individual case; and it is especially important with infants, upon whom leeching produces not only its peculiar effects very powerfully, but, also, more than in after life, the effects that appertain more strictly to general bloodletting. Such is the obstinacy of the depressing change in the instruments of disease, as liable to arise from leeching in infancy, when this remedy has been carried far beyond any useful de-

gree in inflammations of the nature now under consideration and its influence upon the whole extent of the circulatory organs is maintained with such violence, that, having also superadded to it the general effect from excessive loss of blood, it may be impossible to counteract its destructive tendency (§ 514 *g*, 516 *d*, no. 6). It is not alone the effect that arises from an excess of general bloodletting with which we now contend, but a greater, perhaps, in that pernicious change which has been induced in the extreme vessels to which the leeches had been applied, and which, indeed, has been more or less propagated by reflex nervous action over the system (921).

928. From what has now been said, the reason is apparent why cautious leeching may be sometimes a means of relief in those inflammations that are now and then induced by a misapplied or an excessive loss of blood. In these rare affections, the triumph of art is beautifully illustrated when accurately guided by the light of science. The effect should be limited, if possible, to local nervous centers. They are cases, too, in which the distinction between general bloodletting and leeching is forcibly shown, since the former has caused the disease and the latter cures it (§ 1024 *a*, *f*, Dr. M. HALL).—See *Note* p. 708.

2. GENERAL BLOODLETTING.

929. In general bloodletting the effects are varied from those of leeching, and in a way, as we have already seen, of practical importance (§ 927, 928). Its influences may be considered under five general aspects, and successively as in leeching:

930. 1st. The earliest impression is made *simultaneously* upon the organic properties of the large and small vessels throughout the body, since the loss of blood is now immediately coextensive with the whole circulating mass, is suddenly withdrawn, and in a comparatively large quantity. Here, therefore, as of the local vessels in leeching, a change is instituted in the vital state of the blood-vessels throughout the body (§ 526 *a*, 915, 921, 944 *c*).

931, *a*. 2d. The foregoing impression suddenly rouses the arterial system to a greater, but very modified action, by which the vessels, especially the extreme and capillary, are brought into a state of contraction, and far beyond any diminution of their contents that may arise from the quantity of blood removed from the body (§ 916).

931, *b*. The contraction thus instituted is vastly greater in the small than in the large vessels, mainly because of the greater endowment of the former with irritability and mobility (§ 188, 205, 482, 944 *c*).

932. 3d. Owing, also, to the same causes through which the extreme vessels feel the loss of blood more sensibly than the larger ones, powerful reflex nervous actions are determined upon the former by the changes which take place in the larger series of vessels (§ 222–233$\frac{4}{5}$, 409–411, 475$\frac{1}{2}$, 500 *m*, 687$\frac{1}{2}$–688, 694$\frac{3}{4}$, 826 *cc*, 920).

933. 4th. As soon as the foregoing change begins in the vessels, it throws a reflex nervous action over the heart. There is, as yet, so little diminution of the general volume of blood, that the earliest influences upon the action of the heart must be due, entirely, to this reflex nervous impression (§ 919, 500 *m*, 826 *cc*, 829).

934. 5th. As the heart becomes influenced, it excites a powerful reflex influence that falls upon the extreme and capillary vessels; between which and the heart there exist very strong vital and sympathetic relations (§ 385, 526 *a*, 920, 1039).

Here, therefore, as in leeching (§ 920), the contraction, and other changes, which take place in the small vessels, grow out of a double influence; namely, that which is exerted by the direct impression from loss of blood, and that which is reflected upon them by the changes that arise in the heart and larger vessels. And so, as in leeching, reflex nervous action between the heart and blood-vessels passes and repasses, and increases in an increasing ratio as the blood flows from the arm, till its prostrating effect reaches the point of syncope. In leeching, however, the sympathies between the heart and blood-vessels are not as reciprocal as in general bloodletting; but a greater influence is often propagated in leeching by the small vessels upon the centre of circulation (§ 921, and *references* in § 932).*

935, *a*. That the failure of the heart's action does not arise, as commonly supposed, from a mechanical diminution of the volume of blood is shown by the frequent occurrence of syncope from the loss of two or three ounces; nor does it depend, in the least, upon withdrawing the stimulus of blood from the heart. On the contrary, as it respects both hypotheses, the blood is actually accumulated about the heart in consequence of the contraction of the capillary vessels; and this accumulation, from the beginning, is a cause of the failure of the heart's action, and is at its greatest extent when syncope takes place (§ 936, and *references* in § 932).

935, *b*. It is also equally true that the general contraction of the small vessels, in all the modes of abstracting blood, is not referable to either of the foregoing causes; and for the reasons, in part, that the contraction far surpasses any diminution of the general volume of blood, that the phenomenon is always attendant on syncope arising from mental causes, and that the contraction, if proceeding from elasticity or from any other cause than one of a vital nature, could never determine the powerful reflex nervous actions which it exerts upon the heart (§ 916, 917, 932, 937).

935, *c*. In like manner, the diminution of the volume of blood in inflamed parts is only a remote effect of lessening the quantity of the circulating mass. The blood is not only temporarily, but permanent ly expelled from the injected vessels. This shows that its expulsion is effected by a vital change in the condition of the vessels; otherwise, they would not contract in a ratio exceeding that of the corresponding vessels of other parts, nor would their contraction be permanent. Vessels that are enlarged in inflammation to many times their natural diameter are often reduced to nearly their natural volume while the operation of bloodletting is in progress (§ 910, 977, 1056).

Various circumstantial facts might be adduced to show the vital nature of the contraction which attends the capillary vessels. The following are relative to idiosyncrasy; and the principle which I have set forth is an evidence of the accuracy of the reporter's interpretation of the phenomena, throughout. Thus: Dr. Paige, "of large experience and great respectability," states, in the November number (1845) of the "New York Journal of Medicine," that, on bleeding "a woman about forty years of age, and after having drawn a very few ounces, and while the blood was still flowing from the vein, she was taken with very severe pain all over the external parts of the sys tem, and extending to the most remote extremities. I suffered the blood to flow, however, but the pain increased instead of diminish-

* This sensitiveness of the heart and arteries to the nervous influence excited by loss of blood corresponds exactly with that from all things else, as shown in § 500 *m*.

ing." "Several years afterward I met with exactly the same symptoms on bleeding a young man in case of an ardent fever; but, having thought much of the first case above mentioned, I had come to the conclusion, in my own mind, that the pain depended on the *spasmodic contraction* of the small vessels of the surface and extremities as they became emptied of their blood. I, in this case, immediately administered a free dose of some diffusible stimulus (I think, of ammonia), and the pain subsided very soon, so that I was able to take as much blood as I wished" (§ 399, and references in § 932).

935, *d*. Again, bloodletting being, in popular language, a debilitating remedy, its rapidly salutary effects contradict the prevailing hypothesis that inflammation and venous congestion are constituted by debility of the vessels, and stagnation of blood. Had this doctrine any foundation, the capillaries in inflammation, and the veins in congestion, would immediately become more injected with blood, and those diseases should be exasperated by what is known to be their most efficient remedy. It also fully contradicts "coagulation."

The effects of bloodletting, therefore, prove that the pathological cause of inflammation and venous congestion consists not only of an increased energy of the organic properties, but that these properties are also modified in kind; while the rapid subsidence of the foregoing affection, under the influence of loss of blood, proves, abundantly, that the whole process advances upon vital principles. The loss of blood so impresses the diseased properties, that their pathological state is changed on the instant (§ 137 *d*, 143, 150–152), and they are brought to obey their natural recuperative law so immediately, that the vessels of an inflamed eye contract and disappear while the blood is yet flowing from the arm. And so of all other parts that are concealed from observation (§ 476½ *h*, 478, 479, 503–506, 516 *d*, no. 6, 750 *b*, 751, 817).

935, *e*. The extent and durability of this change will depend upon a variety of circumstances; such, for example, as relate to constitution, the nature of the remote causes, and whether, also, the impression have resulted purely from the loss of blood, or, in part, from mental emotions, or from gastric irritation; and it will be often influenced by the *manner* in which the blood may be abstracted, whether from a large or a small orifice, or whether the operation be suspended for a minute and then resumed. Each of these circumstances, also, discloses the nature of the principles upon which loss of blood produces its effects, especially the agency of the nervous influence.

936, *a*. When general bloodletting is practiced in health the action of the heart begins to fail as soon as the vessels begin to contract; but it is the tendency of inflammation to delay or prevent the vascular changes under an equal loss of blood, while, on the other hand, those changes are often promoted by venous congestion, or by numerous adventitious influences, either mental or physical.

936, *b*. Again, it frequently happens, after the action of the heart is more or less subdued by loss of blood, that it speedily recovers its force on account of the removal of the prostrating influence of some morbid condition, or of nausea, or of mental disturbance, which removal may be suddenly effected even in the case of some depressing form of disease, and perhaps as soon as the blood begins to flow from the vein (§ 938, *b*), just as the nervous power may be modified.

937, *a*. Since the influences of general bloodletting are exerted, from

the beginning, simultaneously upon the whole capillary system (§ 930), the amount and rapidity of the primary change will depend on the suddenness with which the blood is abstracted; and whenever loss of blood produces a great and sudden contraction of the whole capillary system, however small the quantity, syncope will approach (§ 935).

937, *b*. And so, also, it was found by Le Gallois and Philip, in their direct experiments upon the brain and spinal cord, that the extent of the nervous influence upon the heart, blood-vessels, and alimentary canal, depended, always, on the suddenness of the impression on the nervous centres, and that when most sudden and violent it was capable of extinguishing at once the functions of life (§ 478, 479, 510, 511).

937, *c*. Now, as will have fully appeared, the sympathetic changes which take place in the heart and blood-vessels, in general bloodletting, depend upon the operation of the nervous power; just as, in the direct experiments by Le Gallois and Philip, the organic functions were variously affected according to the nature of the influences which were inflicted upon the nervous centres. It is, therefore, already apparent that the effects of bloodletting upon disease will often depend much upon the rapidity with which the blood is abstracted. And this important practical consideration points out another difference between general bloodletting and leeching, and why, in the language of Mr. Travers, "syncope is in proportion to the suddenness, rather than the quantity of the hemorrhage." Hence it is that syncope follows from the loss of a smaller quantity of blood when drawn from a large than from a small orifice, or from both arms than when from one (§ 1056); from the more *sudden* excitement of reflex nervous action.

937, *d*. It is also another important practical, as well as philosophical, consideration, that if the subject be in an erect posture, syncope will follow sooner than in the horizontal, from the greater inability of the heart in the former case to transmit the blood to the brain; and this circumstance, as will appear, should govern us as to the position of the patient.

938, *a*. Again, the ratio, in which the various influences that arise from general bloodletting will succeed each other in disease, will also depend on the existing condition of the organic states, especially of the heart and blood-vessels (§ 143, 149, 150, 152). It often happens that an increased and uniform susceptibility pervades the whole sanguiferous system; and when this peculiar state exists, the abstraction of a very small quantity of blood may instantly determine a paroxysm of syncope (§ 526 *a*, 961), the nervous power then acting intensely.*

938, *b*. This proposition, like all the others which are made without qualification, supposes the influences to depend upon the absolute loss of blood, and not to be affected by adventitious causes, such as emotions of the mind, intestinal irritation, &c. When these accidental and transient causes institute their reflex and prostrating nervous actions, they should be carefully noted; since it is commonly important that a certain amount of blood should be abstracted to produce the requisite impression upon disease. In such cases, therefore, it is commonly necessary to go on with the operation, sooner or later, but generally early, after the patient has revived. The nervous influences of the adventitious causes generally make but little or no impression upon disease; and the loss of too little blood often adds violence to inflammation and fever by imparting greater energy to the action of

* See p. 298, § 476½ *h*, 479.

the heart, or by relieving the general circulation when it may be embarrassed by some local venous congestion (§ 988).

3. CUPPING.

939, *a*. Cupping differs in some of its effects from leeching and general bloodletting. Its influences are of an intermediate nature, but are most allied to the latter. It never makes the profound impression upon the vital condition of the parts to which it is applied that is exerted by leeching, and its influences upon the system at large are also less, under equal circumstances. Cupping, indeed, often fails of relief where leeching is speedily efficient. In a general sense, six ounces of blood taken by leeching is probably equal in its curative effects to nearly twice that quantity abstracted by cupping.

939, *b*. In cupping, the blood is abstracted from the larger series of capillary vessels, whose office is probably but little more than to supply the smaller series, in which the organic properties are most strongly pronounced (§ 384, &c.); nor is that action instituted, by cupping, in those vessels from which the blood is taken, that obtains so profoundly in leeching, and upon which no little of the general and local effects depend, especially the peculiarity of the reflex nervous action.

939, *c*. The distinction is also explained by the persistence with which the blood continues to be discharged long after the leeches have performed their office, although smaller and fewer vessels are divided than in cupping, and these few *torn*, while in cupping the blood ceases to escape as soon as the cupping-glasses are removed. All of which is absolute proof that a remarkable change is instituted in the vital condition of the capillary vessels, by leeching, and that the prolonged effusion of blood is in no respect of a mechanical nature, but wholly due to a vital action which is artificially set up in the vessels, and which is not at all instituted by cupping.

939, *d*. It is evident, therefore, from principle as well as experience, that cupping-glasses should not be applied, as is often done, to promote the bleeding of leech-bites. It embarrasses the specific action instituted by the leeches. A mechanical is substituted for a natural process; while, also, as in cupping, the abstraction of blood is so rapid that its effects become more like those of venesection.

939, *e*. Cupping approximates general bloodletting not only in the rapidity with which the blood is abstracted, but in which it determines reflex nervous actions upon the whole circulatory system, and in the quantity of blood which is required for its physiological and therapeutical effects. It is more remotely allied to leeching in the change which is locally induced, though this change is not of a specific character, but consists of a more simple vital contraction of the small vessels that propagates comparatively little impression upon other parts of the circulatory system. When the impression becomes general, it is then mostly due, as in venesection, to the removal of a quantity of blood adequate to a universal influence.

939, *f*. It becomes more and more apparent, therefore, that general bloodletting, cupping, and leeching are in some respects distinct remedies, and that cupping is the least useful and rarely required. The difference between them lies in a difference in the operation of the principles which are common to the several modes. Some of these differences appertain to the cerebro-spinal system, which is far more

concerned in the phenomena of general blood-letting than in the usual effects of leeching, which is apt to engage mostly local nervous centres. The effects of general blood-letting may be obtained in an inferior degree by cupping, through more inconsiderable degrees of the same influences, as, also, in a still lesser degree by applying cupping-glasses in the operation of leeching. The difference in leeching is owing, in part, to a more profound impression upon the sympathetic nerve, though the other methods transmit their influences through this nerve (§ 921, 922).

Of the Nervous Power in its Relation to the Effects of Loss of Blood.

940. This very important element in the phenomena which arise from loss of blood must be amply reviewed. It is the nervous power to which are owing all the remarkable results that are in active progress after the beginning of the constitutional effects of blood-letting. The operation of this power commences at the earliest contraction of the small vessels, and increases in the ratio of that contraction. It is the same power that exerts so vast a range of influences in directing the effects of all other remedial, as well as morbific agents, and whose characteristics have been already extensively considered. The same philosophy, too, is here applicable as in all other cases in which the nervous power is instrumental in organic actions, or in modifying, or in propagating disease (§ 222–234, 450–530).

941. The development of the nervous power from loss of blood is owing to the vital impressions that lead to the contraction of the small vessels. The influence upon the nervous centres is thus of two kinds—that transmitted by vascular contractions in other parts, and that from the contraction of their own vessels; being, in the latter case, analogous to what we have seen to arise from direct experiments (§ 476–494), from the operation of the passions, and from the reflected action of remedial and morbific agents (§ 227, 500, 944 *c*, 1039, 1040, 1056).

942, *a*. Now, therefore, in view of the extensive premises before us, loss of blood, both by its profound influence upon the small vessels of the nervous centres, and by effects transmitted there by vascular contractions in other parts, develops the nervous power in a peculiar manner and in unusual intensity (§ 227, 232). This influence of this power, reflected abroad, increases that contraction of the general capillary system which is at first instituted, in all parts, in general blood-letting, by the direct effect of loss of blood upon the organic properties of the whole system of blood-vessels (§ 930, 931, 944 *c*).—NOTE Q p .1122.

942, *b*. In leeching, the local impression generates an alterative reflex nervous action upon susceptible parts through centres of the ganglionic nerve, and when strongly made is transmitted to the brain and spinal cord and occasions a general reflex nervous influence (§ 113, 224, 893 *a*, *c*). The general contraction of the vessels is thus more and more accelerated as the loss of blood goes on, the nervous power is more and more excited, and prostrates the action of the heart, and this in an increasing ratio as syncope approaches—NOTE DD p. 1132.

942, *c*. There is not, therefore, as has been universally supposed, a withdrawment of the nervous influence from the heart during a paroxysm of syncope; but, on the contrary, an increased determination of that power upon the organs of circulation, which, indeed, is then at its acme (§ 475½, 476½ *h*, 479, 481 *c*, 487 *g*, 500 *m*, 509, 828 *b*, 951 *c*, *d*).

943, *a*. Again, it has been shown by Le Gallois, Philip, and others,

that the stomach and intestines are readily and powerfully influenced by impressions made upon the central parts of the nervous system (§ 491); as they also are, like the heart, by mental emotions. As soon, therefore, as the nervous centres are influenced by loss of blood the nervous influence is felt as well by the stomach as by the heart and blood-vessels. This gastric irritation is propagated back to the brain and spinal cord, and increases their depressing influence on all the organs. This is especially manifest immediately before the occurrence of syncope, which it contributes to hasten. Hence, also, the frequent nausea and eructations, and the intestinal evacuations, which supervene upon the impressions made on the brain and spinal cord, or as syncope approaches (§ 902, *g*). It is for this reason that cathartics often operate during the progress of general bloodletting, when they had failed antecedently, and where no intestinal inflammation had existed to interfere with their effects. And this consideration, by-the-way, is important to the practitioner when he is deliberating whether bloodletting should precede the exhibition of a cathartic or an emetic.

943, *b*. But, it is also true that the intestinal disturbance is often owing to the effect of nervous influence excited by some emotion of the mind (§ 892$\frac{3}{4}$, *b*); when its reaction upon the nervous centres may be equally as great as when the disturbance results from the loss of blood, but has little or no effect upon disease, and may embarrass the practitioner, and sacrifice the patient to an imperfect application of the remedy (§ 938). Nevertheless, it is important to say that exceptions sometimes occur; and when such demonstrations are made, they yield the most convincing proof of my doctrine of the agency of the nervous power in the physiological results of bloodletting, and its alterative influence upon disease by whatever cause the influence may be excited. Thus: "A patient," says Dr. Armstrong, "was so alarmed at the preparation for bleeding, that syncope occurred, and completely stopped an inflammation of the pleura." Again, "cheer up the patient, and he is always sure to do well" (§ 227–230, 232, 1067).

944, *a*. When syncope arises from the depressing emotions, or from other causes whose primary impression is upon the brain, the action of the heart is directly prostrated through the nervous influence, and by a reflex action instituted by the stomach; while a certain depressing effect is exerted by the nervous power upon the extreme and capillary blood-vessels, and an influence from this change is propagated by reflex action to the heart. The succession of changes then, as respects the heart and blood-vessels, begins more on the side of the heart than when they are determined by loss of blood; the contraction of the capillary vessels being also more consequent on the failure of the heart's action than on the alterative influence of the nervous power. We must also explain, in the foregoing manner, the syncope which follows blows upon the stomach, the crush of limbs, surgical operations, &c.; and when death is *suddenly* produced by any of these causes, it is owing either to a sudden extinction of the cerebro-spinal functions, or to a powerful determination of the nervous influence upon the heart, &c., by which the action of that organ is arrested (§ 230, 480, &c., 510, 511). The same is true of the prostrating effects of nausea, and many other accidental influences which spring up during the operation of bloodletting.—*See* § 476$\frac{1}{2}$ *h*, 479, 902 *g*.

944, *b*. Since, therefore, in the case of bloodletting, its influences

are profound, not only on the instruments of disease, but upon the whole capillary system, and the failure of the heart's action is greatly due to this deep impression on their vital constitution, while in the case of the accidental causes the effect consists mostly in a direct depression of the heart's action, and a consequent failure of supply to the capillary vessels, without essentially affecting their vital states, it is obvious that we may not depend on syncope as a test of the influences of loss of blood (§ 959).

944, *c*. The *contraction* of the blood-vessels as arising from loss of blood is an incidental result of a profound impression upon the *vires vitæ*, which is essentially *the cause* of the development and modification of the nervous influence. The *contraction*, therefore, is only an evidence that such profound impression has been made, just as in other exemplifications by cathartics and emetics (§ 889 *f*, 902 *g*). The vascular contraction occasioned by fear, &c., produces no such effects (§ 892¾ *b*, 900, 902, 954 *d*, 961 *e*, 966, 986 *b*, p. 837, § 1057½, p. 827, p. 920 NOTE).

944, *d*. Syncope is often consummated by removing the ligature. In this case the action of the heart had been enfeebled almost to an accession of the paroxysm, and the additional quantity of blood suddenly thrown upon the heart, so far from rousing the organ, overpowers its action. It is in this way, in part, when the heart has been gradually prostrated during the access of congestive fever, that a sudden development of the attack sometimes produces syncope. Something, however, is evidently owing, in this case, to the reflex nervous influence of the extreme vessels upon the heart, but probably more to the sudden determination of blood from the circumference at the access of the cold stage.

945. If syncope be obstinate, the means of relief will be such as operate through the medium of the nervous centres, and should be of such a nature as will subdue the depressing character of the nervous influence, and render it stimulant to the heart and blood-vessels. Pungent vapors to the nose, cold air, cold water dashed upon the surface, stimulants introduced into the stomach and intestine, and exciting means of a corresponding kind, as well as perfect rest, will therefore be the proper remedies (§ 481, *e*, 891½ *k*).

In the *Medical and Physiological Commentaries*, vol. i., p. 178 (1840), I proposed, in cases of obstinate and alarming syncope, the operation of acupuncturation of the heart; deriving my suggestion from Marshall's experiments upon frogs, which were revived by that process when apparently dead from carbonic acid. Very lately (1843), I see in the *Annali Universali di Medicina*, that Dr. A. Carraro has successfully repeated these experiments, and makes the same application to the human subject as had been done by myself. The whole is also commonly supposed to be original with Carraro.

When syncope supervenes, if the subject be laid in a horizontal posture animation returns, and it may be again suspended by reversing the position. These phenomena depend upon causes now essentially modified. "No man ever saw the sensorial functions continue a single minute after the heart had ceased to move. When the body is horizontal, the heart circulates the blood more easily, than when any part, and especially so large a part as the head, is elevated." If syncope return when the head is again elevated, it will depend on a more simple cause than what originally produced it. It will now arise from a permanently enfeebled state of the heart, and "its ina-

bility to continue the circulation, and thus to supply the brain and all other parts with blood;" and such is always the last in the series of causes in a paroxysm of syncope. In the first instance the action of the heart is prostrated through the nervous influence of the brain and spinal cord; in the second, the functions of the brain are impaired or suspended through the enfeebled action of the heart (§ 476½ *f*).

946, *a*. Many examples may be found in my Essay on the Philosophy of the Operation of Loss of Blood, which show the great alterative nature of the nervous power as developed by bloodletting. Let one suffice at present. Thus: "A patient," says Dr. Armstrong, "having lost only an ounce of blood, from the shock of the operation syncope came on, and effectually removed an acute inflammation of the brain" (§ 476½ *h*, 478, 479, 494, 509–511, 827 *d*, 828 *b*, *c*, 943).

946, *b*. Examples of the foregoing nature admit but one interpretation. They are clear illustrations of the peculiar properties and laws by which organic beings are governed. They are simple elements of the whole philosophy of which I have spoken, as it respects the specific nature of the properties and actions of life, of their mutability, and of the tremendous influence which the nervous power is capable of exerting upon them. It is the same, also, when life is instantly extinguished by a drop of hydrocyanic acid, or of the alcoholic solution of the extract of nux vomica, applied to the tongue, or by a blow on the epigastrium, by surgical operations, &c., through reflex actions of that power (§ 222, 455 *d*, 476½ *h*, 479, 500 *c*, 509,828).

947. The philosophy of syncope, as expressed by M. Piorry, has been the philosophy of no small part of the medical world; while all the antecedent influences of bloodletting have been more universally referred to the mechanical diminution of the circulating fluid, and syncope construed upon this doctrine.

"*Syncope*," says the eminent Piorry, "*whatever may be its cause, consists in a suspension or diminution of cerebral action. If it take place spontaneously and from a moral cause, it is the action of the encephalon that is suspended; it is the influence of this organ upon the heart which is diminished.*"

We have seen, however, in the ordinary state of the body, that the nervous system has little other influence upon the organic functions than that of contributing to their fundamental action; these functions being all carried on by the organic properties, which are maintained in operation by stimuli peculiar to each, but mostly by the blood. The nervous power becomes a stimulant, or depressant, or modifying cause, to the organic and animal functions only as developed by those stimuli or by other physical or moral causes (§ 177–191, 223, 226, 227, 232, 478, &c.). It is also fully demonstrated that the entire removal of the brain and spinal cord does not affect the action of the heart, if respiration be artificially maintained (§ 477, 479, 481 *h*), when the muscular motion of the heart is excited by reflex action of the ganglionic system (§ 475½). When we consider, also, how powerfully the heart may be influenced by slight mechanical or other agents applied to the brain, or spinal cord (§ 480, &c.), even when the cerebral circulation is destroyed, and the whole inferior portion of the organ removed, we shall better understand, in this way, how loss of blood, odors, offensive sights, and mental causes, produce syncope, than by supposing that it is through their direct suspension of the cerebral

functions. Violent passions have, doubtless, the effect of extinguishing, at once, the powers and functions of the brain; but then the action of the heart ceases at once, and is clearly owing to the sudden lesion of the brain, while in syncope the action of the heart is only diminished. Nevertheless, even in the former case, a pernicious nervous influence is suddenly determined upon the whole circulatory system (§ 479, 509, 510). Again, it is only the depressing emotions, like fear, grief, disgust, and such causes as in any degree exert a sedative influence on the circulation, that are known to produce undoubted syncope, while those like joy and anger, which always excite the action of the heart, alone extinguish life instantaneously. One affection, too, is common, while the other is rare; and when the latter takes place it is probable that there exists an apoplectic predisposition. In one case the action of the heart is suddenly depressed; in the other it is powerfully excited. Doubtless, too, in the latter instance the violent impulse of the blood upon the brain contributes, *per se*, to the sudden subversion of the cerebral powers. While, therefore, in syncope from fear and grief the blood is, at the onset, diverted from the head; in sudden death from joy or anger a preternatural quantity is determined upon the brain (§ 227, 476½ *h*, 500 *m*, 826 *cc*).

948. It appears, therefore, that the various changes which take place in the action of the heart, when they arise from loss of blood, are chiefly dependent on reflex nervous influence, or remote sympathy, and that this influence is greatest when syncope ensues (§ 481, *h*). Nor is there at any stage of that complex series of changes, from the first impression that follows the loss of blood to their end in syncope, a deficiency, but a redundancy, of blood at the centre of circulation; and, if death ensue, the vital fluid is always found accumulated in the cavities of the heart (§ 1039).

949. Summarily, also, we have now seen that it is the effect of loss of blood, *per se*, to so modify the vital states of the capillary blood-vessels as to result in their contraction, and that when this contraction begins in the vessels as the effect of the loss, it excites the nervous influence in proportion to the extent and suddenness of the impression; that this influence is then propagated abroad, and increases the contraction of the capillaries at large; that this effect of the nervous influence is reflected back upon the nervous centres, by which the nervous influence is still farther excited; that circles of reflex actions become thus established; that the nervous influence is now, also, exerted with a depressing effect upon the heart, and intestinal canal, and that this effect is reverberated upon the brain and spinal cord, by which the intensity of the nervous influence is farther increased; that the reflex nervous actions, and the multiplying causes of nervous influence, become, therefore, exceedingly complex, and increase in their ratio till the heart is prostrated by that influence and by the central determination of blood, when syncope takes place as an immediate consequence (§ 476½ *h*, 481 *h*, 500 *m*, 944 *c*).

But, we have also seen, that if too little blood be taken, in certain conditions of disease, results of an opposite nature to the foregoing, and an aggravation of disease, may ensue, though they will be brought about through the same physiological principles (§ 965, 983–989). Natural laws are at the foundation (§ 901, 904 *a*, *bb*).

And now I say, if the foregoing results of loss of blood be com-

pared with the effects of other remedial or morbific agents, it will be found that a close analogy and harmony of laws distinguish their modus operandi. And such is always the simplicity of nature in her fundamental institutions (§ 137 *e*, 150–152).

950. From what has been now seen of the profound influences of bloodletting upon the nervous centres, especially when syncope approaches, we readily account for those inflammations, and that far overrated irritation of modern physicians, which occasionally supervene on the loss of blood (§ 1020–1023); sometimes, though rarely, from an excess of the remedy, but more frequently from its deficiency, and still more so from its frequent application in small quantities where a greater loss is demanded. If the loss be excessive, or blood-letting not appropriate to the case, it gives rise to a morbific reflection of the nervous power upon the capillary blood-vessels. When the loss is small and frequently repeated, an irritable state of the whole vascular system is thus established, which may not only increase the inflammation which the remedy was intended to subdue, but may become the foundation of disease in other parts (§ 476½ *h*, 479, 500 *m*, 965 *b*, 982–1001, 1005 *e*, 1024; also, Kriemer's *Experiments*, § 485).

In all these cases the whole system of capillary blood-vessels has a large share in the primary impression; but a peculiar influence is determined upon them by the violence inflicted on the extreme capillaries of the brain. Inflammation, therefore, may be lighted up, as a consesequence, either in the brain or some other part, but especially the brain (§ 230, 231). Hence, also, the general vascular excitement, and that delirium, coma, stertorous breathing, and those convulsions, retchings, and involuntary intestinal evacuations; some of which so frequently follow excessive loss of blood. Although blood-letting, therefore, be a remedy for inflammation, the excessive use of it, as will be farther shown, may induce that affection; and even then the cautious abstraction of blood by leeches still proves, by its curative influence, as reported by some, the nature of the affection, and the sanative power of the remedy when well directed (§ 901, 997, 1024 *a*, 1057).*—Note Q.

951, *a*. Let us now regard the foregoing morbific effect of loss of blood (§ 950) in connection with two examples, one of coincident, the other of an opposite, nature, to show the effect of the nervous power upon the capillary vessels of all parts, as illustrative of this agency in the operation of blood-letting, as well as of all other remedies. The first example is the greatest glance that has been made toward the practical philosophy of the nervous system as expounded in this work, and as first developed in the *Med. and Physiolog. Comm.*—Thus:

"It is certain," says Müller, "that nervous influence is the principal cause of the accumulation of blood in the capillaries of certain parts during the state of vital turgescence." "In the instantaneous injection of the cheeks with blood in the act of blushing, and of the whole head under the influence of violent passions, the local phenomena are evidently induced by the nervous influence. The active congestion of certain organs of the brain, for example, while they are in a state of excitement, is a similar phenomenon" (p. 827, p. 920 Note).—Note Q.

These several examples, however various may be the remote causes of the phenomena, are so nearly alike that they may be regarded as one,

* The curative effect is to be explained by leeches operating through *local* nervous centers. See § 497, 893 *a*, *c*, 923 *d*, 939 *f*, 974 *b*, 1024 *a*.

and it is not less obvious that they involve the philosophy of inflammation as induced by loss of blood, or as it springs from other causes.

951, *b*. And now for the opposite result, which is brought about by precisely the same immediate exciting cause, the nervous influence, though not so supposed by the distinguished observer.

"When a patient," says Dr. Armstrong, "had lost only an ounce of blood, from the shock of the operation syncope came on and effectually removed an acute inflammation of the brain." Again, "a patient," says the same writer, "was so alarmed at the preparation for bleeding, that syncope occurred, and completely stopped an inflammation of the pleura" (*See* § 476½ *h*, 479, 955 *a*).

951, *c*. Looking at the foregoing examples in their true relations, there may be advantageously considered, besides their immediate object, certain other points which reflect a strong light upon the nature of the nervous power, the causes and mode of its development, its modifications by the nature of its exciting causes, its subsequent propagation to parts remote from the brain and upon the brain itself, and its remarkable influences upon all parts. In the examples before us we see that power variously and in unusual operation. We see that it is positively developed by excessive loss of blood, by shame, by the violent exciting passions, producing a high arterial action, or inflammation of the brain or of other parts in one case (§ 950), instantaneous injection of the cheeks with blood in another, and the brain and whole head in another (§ 951, *a*); and these are corresponding results. We see, also, that an exactly opposite effect is produced by the loss of only one ounce of blood, and in another instance by the operation of fear alone (§ 951, *b*); an acute inflammation of the brain being overthrown in the former case, and an inflammation of the pleura in the latter. The common nature of the modifying cause cannot be mistaken; and when we consider the variety of more remote exciting causes, excessive loss of blood in one case, an ounce in another, shame, anger, and fear in others, the close analogies, yet diversified results, in one series of the cases, and the absolute opposition in the other series, yet each example in this series exactly alike, though involving the loss of an ounce of blood in one of the instances and fear in the other; when, I say, we consider these things, we must admit not only the common nature of the intervening cause, but that this cause is liable to be variously modified by the agents which rouse it into action, and that, however apparently estranged from each other may be many of these agents, they modify the incidental cause in modes corresponding with the effects. A common philosophy applies, therefore, to all the cases, and this philosophy is equally true of those morbific and remedial agents which determine the same effects upon distant parts when applied to the alimentary canal, or to the skin, &c., and therefore, also, of the whole compass of remote sympathy. The type of the whole is in the examples before us (§ 475½, 500 *m*, 1056).

951, *d*. It is farther worthy of remark that the examples (§ 951, *b*) show how powerfully the nervous influence may be determined upon the organic constitution of the brain by the loss of a single ounce of blood, and in the case of the pleuritic inflammation by fear alone; while either case is a conclusive proof of the philosophy which I have propounded of the modus operandi of bloodletting, and that it is in no respect of a mechanical nature. These examples also demonstrate my position that the nervous influence is most profoundly felt when syncope comes on.

952, *a.* Some of the finest illustrations of the effect of bloodletting upon the organic properties of the extreme vessels of the arterial system, either directly through the loss of blood, or, by alterative reflex nervous actions, are shown by the changes which take place in the blood while flowing from the arm in inflammatory diseases.

952, *b.* Some of the most remarkable of the foregoing changes may be induced by a very small loss of blood. Thus, a patient of mine was attacked with pneumonia, after convalescence had begun from a protracted fever. She was placed in an erect posture, and an ounce of blood was drawn, in a full stream, into each of three wine-glasses; when syncope took place. In the first glass the blood had a thick, strong, indented, buff, and a fimbriated edge; in the second the buff was sensibly less, and the other peculiarities were diminished; in the third they had disappeared.

952, *c.* On the contrary, however, in a case of inflammatory fever Hewson observed the unusual phenomenon of the appearance of the inflammatory buff only on the fourth cup.

952, *d.* "There is a very considerable difference to be sometimes observed in the quantity of coagulable lymph in blood taken in different cups from the same patient at the same bleeding. In some instances this difference has been observed nearly one half."—Wardrop. Sometimes more than one half.—Scudamore. "The same is relatively increased during the continuance of bleeding; and it is surprising how great a change will take place in this respect at minute periods."—Thackrah. And so Gendrin, Stokes, &c. Again, however, the foregoing phenomena are sometimes directly reversed; and an increased quantity of fibrin, and a diminution of serum, have been found in each successive cup. These conditions, too, as well as the preceding, depend, in a measure, upon the rapidity with which the blood is abstracted. Mead, the able humoralist of other days, observes, that "the blood may certainly undergo any imaginable changes by alterations made in its motions only" (§ 500 *m*, 687½).

952, *e.* If syncope take place, the blood not only generally loses its inflammatory characteristics (*b*), but the clot is often much softer and more voluminous. Should the inflammation afterward go on, the blood will be found to have resumed its former peculiarities.

952, *f.* Blood, drawn from a person, or from an animal about to faint, coagulates very rapidly. In this case, the rapidity of coagulation appears to bear a remarkable ratio to the depression of the organic properties of the solids; as may be readily seen in slaughter-houses. But, again, on the other hand, when death is suddenly produced through the nervous system by blows on the stomach, apoplexy, &c., or by running, lightning, organic affections of the heart, &c., or when the powers of life are greatly reduced by malignant fevers, the blood generaly, though not always, remains fluid.

These seeming paradoxes are resolved by supposing peculiar influences of the solids upon the blood, according to the specific modifications of their organic properties; these, as well as all the other differences and changes, being, therefore, an evidence that bloodletting produces its effects upon the *vires vitæ* of the solids, and that the organic properties, other things being equal, will be affected according to the quantity of blood taken, the manner of taking it, &c.

952, *g.* Musgrave, in adverting to the rapid changes which take place in the blood during the operation of general bloodletting, re-

marks that these alterations "require the agency of some third power; for to suppose that the blood undergoes so sudden a change merely by the quantity being lessened, would hardly be more extraordinary, than to imagine that pouring a glass of brandy out of a bottle would turn the rest into cider" (§ 1087).*—See KRIEMER's experiment § 485.

952, *h*. How futile, therefore, the recent observations of Andral as to the relative quantity of lymph in inflammatory diseases! The most bloodless subjects are often liable to inflammation, and the loss of one or two ounces may affect, essentially, the proportion of lymph in the next two ounces (§ 688 *ee*). Here, therefore, is proof in the very nature of things, which stamps all these inquiries as humoral assumptions. Indeed, Andral, himself, had long before settled the fallacy of these later observations by the well-grounded statement, in his Pathological Anatomy, that "no one solid can undergo the slightest modification without producing some derangement in the nature and quality of the materials destined to form blood, or to be separated from it." And this, too, from the father of modern humoralism (§ 699 *c*).

GENERAL AND PRACTICAL OBSERVATIONS ON BLOODLETTING.

Of the General Extent of the Remedy.

953. The vital influences of loss of blood originate in the vital relations of the blood to the organic properties of the solids. The blood being the *pabulum vitæ*, the solids are extremely sensitive to any loss of this fluid they may sustain. This sensitiveness resides in the organic properties (§ 184, &c.). Inflammation and fever being also essentially constituted by a morbid condition of those properties (which are more susceptible for being thus affected (§ 137 *d*, 143 *c*)), the loss of blood, especially in general bloodletting, makes an instantaneous and profound impression upon them, by which their morbid condition is so radically altered that nature reacts at once, and sometimes completes the cure almost on the instant (§ 137 *e*, 151, 152).

954, *a*. There can be no general rule as to the quantity of blood which should be abstracted in any given case of disease, or as to the rapidity with which the abstraction should be made. This must always depend upon the circumstances of each individual case, and upon the effects of the remedy during its application, which should, of course, be superintended by the physician (§ 675).

954, *b*. It is, nevertheless, certain, in a general sense, that some definite quantity of blood should be removed; and this, according to the nature of the affected organs, the character and intensity of the disease, &c. (§ 133–156). This is necessary not only to the present effects, but to the permanent influences of the remedy. This permanence cannot often be maintained without the continued operation of a certain diminished supply of blood to the general capillary system (§ 514 *g*, 516 *d*, no. 6). Dry cupping, therefore, and all similar expedients which are prompted entirely by erroneous views of the modus operandi of loss of blood, produce none of the effects which appertain to bloodletting in any of its modes. I cannot, therefore, accede either to the dry cupping of the distinguished mechanical physician, Dr. Arnott, or to his opinion "that it is a great modern improvement in the practice of the healing art, in bleeding for the cure of inflammation to take the blood away *as quickly as possible;* since

* This conclusion was no farther theoretical, but was founded upon a common-sense view of the exigencies of the case.

intense inflammations of the brain, lungs, bowels, &c., are equally removed by faintness, whether it happens after the loss of two ounces of blood, or of fifty."—ARNOTT'S *Physics, &c.*

954, *c.* In general bloodletting, the nearer the loss is carried to the point of syncope the more profound and permanent will be its effects. In grave forms of inflammation and fever this amount of influence is required. and perhaps at repeated applications of the remedy (§ 999).

954, *d* When syncope is induced by loss of blood alone it is a test that the vital condition of the small blood-vessels has been strongly affected; but more or less so, in a general sense, in the ratio of the quantity abstracted. Like the contraction of those vessels, syncope is one, though a less simple, consequence of the vital impression exerted upon them (§ 944 *c*, 961 *e*).

955, *a.* It should be said, therefore, in qualification of the statement in section 951, *b*, that it is exceedingly rare that the loss of a single ounce of blood, by venesection, will subvert inflammation of any organ, especially of the brain, even though the nervous influence be so intensely developed as to establish syncope (§ 961, *c*). The following are common examples, and go with the others to illustrate my doctrine of the nervous influence. Thus, Dr. Armstrong:

955, *b.* "A patient, at the point of death from acute inflammation of the pleura and lungs, was bled to the extent of fifty ounces, when he had obtained no relief. If we had stopped here, in two hours the patient would have died. After abstracting about six ounces more blood syncope came on, from which he recovered convalescent."

If this patient had been bled in an erect posture and from both arms, and had syncope followed the loss of fifteen or twenty ounces of blood, it is scarcely probable that he would have been saved.

Again, another patient of Armstrong's "had been once bled, after which the inflammation of the pleura and lungs returned. He had nearly expired from the bleeding; but the symptoms were so urgent that I determined to bleed him decisively, and I told his friends that he might perhaps even die under the operation. I bled him decisively, and syncope came on suddenly and continued some time, so that I thought he would have died. He recovered afterward with small doses of calomel and opium" (§ 892$\frac{4}{5}$, *i*, 1068).

955, *c.* Examples of the foregoing nature have been of constant occurrence, in the hands of enlightened understanding, from the time of Hippocrates, who began the example. The proper rule in extreme cases was observed, as above, by Armstrong, and was thus laid down by Celsus: "It may happen," says Celsus, "that a disease may require bloodletting when the system seems unable to bear it. Yet, if there appear no other remedy, and the patient must perish unless relieved by a rash attempt, it is then the part of a good physician to declare that bloodletting is the last resource of his art, but that it may precipitate death. Having done this, he should bleed, if desired. There can be no room for hesitation in cases like this, since it is better to try a doubtful remedy than none at all. And this ought especially to be done when a paroxysm of fever has nearly destroyed a patient, and another equally severe is likely to follow. So, also, in palsy, and, again, when angina suffocates" (§ 892 *c*, 892$\frac{4}{5}$ *i*, 1068).

955, *d.* Here the importance is fully shown, not only of abstracting a certain quantity of blood, but of obtaining a full impression from the

cerebro-spinal influence, in many cases of inflammatory affections, as, also, the error of Marshall Hall's recommendation that "bloodletting should never be carried to actual syncope, but only to the very first signs of approaching syncope, which is, in fact, to be prevented by immediately laying the patient in the recumbent position." Many examples of the foregoing nature are presented in the *Commentaries*, and others will follow in the present work.

955, *e.* Where bloodletting has been already carried to a large extent, yet the original disease still perseveres; or when we are called at the advanced stages of inflammation or fever, or where inflammations may spring up in subjects exhausted by long confinement, or in broken-down constitutions, the rules of practice are less precise, and depend more upon the circumstances of each individual case. But, in a general sense, so long as any severe or obstinate inflammation may be present, whether acute or chronic, we shall scarcely go wrong in abstracting more or less blood, not seldom freely, either by the lancet or by leeches. This is the dictate of philosophy, and it is enforced by the soundest experience. They are often cases, however, which demand habits of critical observation, accuracy of judgment, and an unremitting attention to medical pursuits. Otherwise, it will be often but little better than the hazard of the die. Without these requisites, where uncertainty prevails in critical conjunctures it is better to leave the whole matter to nature. In such emergencies she will oftener triumph than the unskillful practitioner, who may only embarrass her efforts. "*Medici plus interdum quiete, quam movendo, proficerunt.*" This principle holds in the foregoing cases where art is imbecile from ignorance. And so it is from inadequate bloodletting in the early stages of inflammation and fever.

But, let it be remembered that the two most important objects to be considered in the treatment of disease is,

1st. *To adapt our remedies in all respects to the nature and existing condition of the pathological states.*

2d. *To carry them as far as and no farther than the institution of such a change as will enable Nature to take upon herself, most successfully, the work of cure* (§ 857).

956. General bloodletting is the proper mode of depletion, especially after the age of infancy (§ 576, *e*), in all forms of fever, and in all the active inflammations of the internal viscera. This is particularly required at the beginning of the treatment, on account of the universal change which general bloodletting induces in the sanguiferous organs; thereby relieving, at once, the instruments of disease of a redundant quantity of blood, and immediately reducing the force with which the blood is distributed. There is also thus obtained a farther important advantage from the potent reflex nervous influence which is determined upon the instruments of disease by a great and sudden change of action throughout the arterial system, as well as from influences exerted upon the general vital conditions of numerous organs; the very effect upon the skin, for example, and especially upon the intestinal canal, reflecting a nervous influence upon other organs which may be the seats of disease; just as when antimony or ipecacuanha send their influences abroad in a more direct manner through the intestinal mucous tissue, or call up the co-operation of the skin with that tissue in subduing pulmonary inflammations (§ 514, *h*), by exciting a complex circle of reflex nervous actions.

957. On the other hand, if the treatment have been begun by other remedies, or if it have been neglected, and disease have thus acquired the force of habit (§ 539), or if general arterial excitement have existed and gone down spontaneously, or, in neglected cases, under the influence of remedial agents, even of loss of blood, and however suddenly, the results in the preceding section can be obtained only in an inferior degree by general bloodletting. Comparatively little change of action may then be induced in the vessels generally; or the effect of general bloodletting may be lost in the influence of habit (§ 539, &c.). Here, too, the remedy is on a par, in principle, with all others. Nevertheless, general bloodletting is likely to be important at any stage of visceral inflammation so long as the disease exists in much intensity; whatever treatment may have been pursued, or however the disease may have been neglected. But, should a manifest abatement have followed under any of the foregoing circumstances, leeching may then become far more efficient than venesection (§ 892$\frac{1}{5}$ *i*, 1008).

958, *a*. In the ordinary forms of active inflammation, and where practicable in fever (§ 961–970), the first bloodletting should be the largest, and this should be in proportion to the exigencies of the case. We may often accomplish all that is desirable by a single blow, as it were; which is incomparably better, in grave inflammations and fevers, than a dozen smaller ones, which may even fail, or prove detrimental, in the end, where greater decision, at the onset, would have completed a cure (§ 950, 965).

958, *b*. It appears, also, from what has been said, that the operation of general bloodletting should always be conducted by the physician; and it is doubtless owing to disappointments that have arisen from consigning the application of this important remedy to the hands of barbers and leechers that it has fallen into disrepute with many. Leeching may be done by the unprofessional, because it operates upon a modified principle from that of general bloodletting; and it is much less important as to the precise quantity of blood which should be abstracted, particularly on account of *slowness* (§ 476$\frac{1}{2}$ *h*, 921, 937).

But, in general bloodletting, every thing may depend upon an exact effect at the moment of the operation; and that will depend not only upon the precise quantity of blood abstracted, but upon the position of the patient, the size of the orifice, the flow of the blood, the management of the patient's mind so that mental emotions shall not interfere, and upon other well-regulated influences which the skillful physician can alone determine, and alone estimate. Nor can the most experienced and gifted practitioner ever foretell, in any given case of disease, what quantity of blood should be abstracted, by the general method, under the best-regulated circumstances.

This practice of intrusting the operation of general bloodletting to the ignorant will cease to be tolerated when the *modus operandi* of the remedy shall come to be appreciated and acknowledged; nor, until then, will it undergo in the hands of the professional that just application, according to the exigencies of disease, which rarely fails to illustrate its remedial effects.

958, *c*. I must now refer the reader to those divisions of my subject where the distinctions are considered between leeching, general bloodletting, and cupping, for other remarks relative to the just quantities of blood that should be abstracted in certain given forms of dis-

ease, and which were there introduced for the purpose of illustrating the distinctions between those several modes of bloodletting.

959, *a*. Finally, therefore, from what has been now said of the principles upon which bloodletting operates, as well as from experience, the rule as laid down by Dr. Marshall Hall, and other late writers, that "*Syncope is a uniform criterion of the quantity of blood to be abstracted, and which the nature of the case may demand*," is fallacious. Dr. Wardrop gives us the same rule. "The state of fainting," he says, "is to be considered an index of the quantity of blood which is necessary to be removed for the *relief* of the disease." On the contrary, syncope may depend on so many other causes than loss of blood, the actual tolerance at the first operation may be so little that its repetition may be indispensable soon after the patient revives, and perhaps to a large extent even before binding up the arm. These cases of early syncope, where the remedy may be appropriate, are, also, the very ones which most demand repeated abstractions of blood; *and the effect produced at each application of the remedy should be the measure of the quantity to be abstracted* (§ 687½, 688 *d*, *e*, 936–938, 943, 944, 961, 967, 981–988).

959, *b*. "Dr. Moseley," says Robert Jackson, "advises us to bleed, *ad deliquium*, in yellow fever. I coincide with him in recommending extensive bleeding in this form of disease; but I do not accede to the rule which he assumes for judging of the measure. It is vague and uncertain. Deliquium occurs sometimes from the loss of a few ounces of blood, sometimes scarcely from the loss of six pounds. The act of fainting is not, therefore, a rule of dependence for regulating practice" (§ 992, 994).—NOTE FF p. 1135.

960, *a*. Many expedients have been attempted as substitutes for bloodletting; from the comparatively rational method by cathartics, blisters, and other subordinate antiphlogistics, to the ne plus ultra of dry cupping. It would be difficult to assign their appropriate rank, in theoretical conceptions, to some of the novelties which have been brought forward, from time to time, to fulfill, or to surpass, the intentions of bloodletting, or to banish this principal remedy from the healing art. Louis undertook its explosion with more signal success than any other champion of the "meditation upon death." (See *Examination of the Writings of M. Louis*, in *Med. and Phys. Comm.*, vol. ii., p. 679–815.) Others, more inclined than Louis to lend a helping hand to nature, resort to bold experiment, whose evil results, if incident to bloodletting, it must be allowed, would consign this remedy to a well-merited reproach. Thus Pereira, in his Materia Medica, remarks that,

"*I tried tobacco somewhat extensively, a few years since, as a substitute for bloodletting in inflammatory affections. But, while it produced such distressing nausea and depression, that it was with difficulty I could induce patients to persevere in its use, I did not find its antiphlogistic powers at all proportionate, and eventually I discontinued its employment.*"

Such, then, is the philosophy which rears itself against the well-tried and faithful agent; while it is regardless, by its own showing, of the disastrous results of agents long since condemned as fruitless and destructive, and would vainly endeavor to "substitute" them for the safest and only effectual remedy for all grave inflammations.

When Pereira undertook to "substitute tobacco for bloodletting in inflammatory affections," it was with the full knowledge that its use had been mostly abandoned, as wanting in curative virtues, and hostile to life; that surgeons, even, had greatly forsaken it as an enema in strangulated hernia, on account of the frequent deaths it had produced (§ 892$\frac{3}{4}$ *b*, 893 *n*). It was mainly such diseases as confirmed dropsy, tetanus, intractable ileus, and hydrophobia, that were handed over to its tender mercies. Nay, more; our able author says of it, himself, as employed for the relief of dropsy, that,

"In small doses, it is an uncertain diuretic, and in larger doses it causes such a distressing nausea and depression, that practitioners have *long since* ceased to use it in dropsical cases."

How many perished under the experiment with this unmanageable poison in Pereira's attempt "to substitute it for bloodletting in inflammatory affections," either from the direct effect of the poison, or from the neglect of bloodletting, our author does not say; though confessions here would have been some atonement to science and humanity.—NOTE H p. 1117.

Nor may the contemners of bloodletting, and of those who commend its judicious use, in the treatment of inflammations, complain when "their poisoned chalice is thus commended to their own lips."

Were we to contrast the victims of tobacco, alone, during its rage as a panacea, with such as may be assumed to have fallen, through all time, by the lancet, it will not be denied by the stoutest prejudice that the odds are fearfully on the side of the poison. It is profitable, therefore, to pursue this inquiry, and to interrogate yet farther the disposition which may exist in the most enlightened quarters to hold on upon the worthless, but deadly engines of the Materia Medica. The tendency may be, at least, to induce a greater toleration of the useful means, and thus to compensate, in a measure, for the effects of poisons when administered in what are regarded as their therapeutical doses.

We may, therefore, consult another eminent writer of our own day, the able author of the *American Medical Botany;* though he does not say, nor have we reason to think, that he had "attempted to substitute tobacco for bloodletting in inflammatory affections." I make the quotation, therefore, to show how there will sometimes escape from the best writers and practitioners an apparent justification of the worst practices humanity is called upon to encounter; and to contrast the tacit acquiescence of all in commendation of poisons which operate with deadly effect in their authorized doses (and not unfrequently conceding, at the same time, the consequences here alleged), with the denunciations of bloodletting which are wafted from transatlantic shores to startle Americans into mute astonishment.* Thus, then, our author:

"At the present day," he says, "tobacco does not seem to be extensively in use, having passed into neglect rather because more fashionable remedies have superseded it, than because it has really been weighed and found wanting."

In this respect, the able writer is manifestly at fault; and if we only turn over this same leaf from which I have made the quotation, we shall read on the next page as follows:

"This powerful medicine has been also employed with some palliative effect in hydrophobia, and certain other spasmodic diseases. Its internal use, however, requires great caution, since patients have,

* This must now be qualified, as at p. 760 *note*, and NOTE MM p. 1141.—1865.

in various instances, been destroyed by improper quantities administered by the hands of the unskillful or unwary. Notwithstanding the common use and extensive consumption of tobacco in its various forms, it must unquestionably be ranked among narcotic poisons of the most active class. The great prostration of strength, excessive giddiness, fainting, and violent affections of the alimentary canal, which often attend its internal use, make it proper that so potent a drug should be resorted to by medical men, only in restricted doses, and *on occasions of magnitude.*"

Here, then, we are justly told that tobacco should be used with caution even in hydrophobia. And, suppose it could be said of bloodletting, as the writer affirms of tobacco, that "patients have, *in various instances*, been destroyed by improper quantities," even though a part of the injury might be ascribed to "the hands of the unskillful and unwary;" the advocates of the remedy would scarcely allege, on seeing it fall into disuse, what the foregoing writer does of tobacco, that "it has passed into neglect rather because more fashionable remedies have superseded it, than because it has really been weighed and found wanting." No; they would acquiesce upon the ground that it "had been weighed and found wanting." And now suppose, again, that such "weighing and wanting" were plausably affirmed of bloodletting, as is conceded, in reality, by its best advocates, of tobacco, even in the hands of the best practitioners,—in their own hands,—or only through ignorance and carelessness alone, the remedy would be so hunted down that the rational treatment of inflammations and fevers by bloodletting would probably subject the practitioner to public odium. Indeed, we know that this was remarkably the case with the illustrious Robert Jackson, when he first began the explosion of the tonic and stimulant treatment which prevailed so fatally in the British Army. He was generally denounced as "a murderer" by the British Doctors; till the astonishingly diminished mortality in the British Army soon showed them who the real murderers were (§ 569, *e*). On the other hand, however, with what calm indifference we contemplate the ravages of the tonic and stimulant treatment of fevers, and the no less inconsiderate use of the most violent agents of the Materia Medica, for the mere purpose of devising some expedient that shall do away with the necessity of bloodletting in acute inflammations and fevers! (§ 1065, *c*, *d*, 1068, *a*).*

As to tobacco, in the treatment of strangulated hernia, we possess in tartarized antimony, or even in the lobelia inflata, far better and safer means for establishing a relaxation of the muscular system; especially in the former agent. Nay, in very many cases, bloodletting, to the extent of syncope, will not only accomplish the intention as fully, but bestow the immense advantage of subduing any inflammation of the intestine, which is so apt to be produced by strangulation. Besides the immediate hazard of life which is incident to enemas of tobacco, there is the great objection, that should it fail of its contemplated purpose the prostration which it occasions will render an operation by the knife of very doubtful result, but which might have been perfectly safe before the administration of the tobacco. The patient will be little apt to bear the superadded shock which is inflicted by so severe an operation; and the intestine, too, in a state of inflammation which will now contribute greatly to the same general ex-

* Notes F p. 1115, H p. 1117, Gg p. 1138, Mm p. 1141.

haustion. And since the question, among surgeons, has turned mainly upon the abstract effect of tobacco as an agent of *immediate* death, and without much reference to those ulterior results, and since it is no proof that a remedial agent does not destroy because the patient survives its immediate operation, I may also say that its pernicious tendency reaches these cases in the obstacle which it places in the way of subsequent bloodletting, which is often important to the patient soon after the reduction of the intestine, if it have not preceded it (§ 576, *e*).*

But, it is not alone this or that agent, or other individual means, which has been attempted as a substitute for bloodletting in the treatment of inflammations. The whole class of poisonous agents to which tobacco belongs has been declared on high authority, as we have seen (§ 891, *c*), to be "the most important medicines we possess." And to justify yet farther what I have said of British therapeutics, and to sustain the contrast with American philosophy and practice (§ 349 *d*, 350¾ *k*, *kk*, 709, *note*), I shall quote Pereira's *Materia Medica* relative to his opinion of opium when compared with the uses of bloodletting, cathartics, antimonials, &c.

"*Opium*," he says, "*is undoubtedly the most important and valuable*

* The fascinations which attend tobacco as a luxury led to its extensive use as a remedy for disease; and the question arises whether, from what is now known of its pernicious effects when applied to the gastro-intestinal mucous membrane, and even to the skin, in health as well as disease, its moderate use as a luxury can be justified by the physician? This question I shall briefly investigate, for another purpose, also;—that of illustrating yet farther certain peculiarities of remedial agents in relation to vital habit (§ 535, &c.).

There could be little doubt, upon principle, that the various modes of using tobacco would be detrimental in most conditions of disease, on account of the increased susceptibility of organs (§ 137 *d*, 150, 151). But it would be still a question of facts in relation to this particular agent (§ 650). The requisite facts are before us, and are decisive against the luxury in morbid conditions.

But, this does not prove that the moderate use of tobacco will injure the health of those who are in possession of health (§ 137, *d*). We cannot reason, as I have endeavored to show, from the effects of remedies upon man in health to man in disease; excepting as it respects their violence when manifested in healthy subjects. Of this principle tobacco affords a very full exemplification, and shows that the principle is equally true in its opposite aspect, and that we may not reason from the effects of an agent which is deleterious in disease to its effects under the condition of health; as, indeed, is shown by food itself.

We must, therefore, take the facts in all the cases, and what other facts teach us as to the constitution and laws of organic beings, and as agents operate upon different parts. With this kind of philosophy, we are enabled (unexpectedly, according to the usual method) to decide that the moderate use of tobacco is rarely deleterious in health, and has, therefore, but little, if any, tendency to abbreviate life. The law of vital habit, as well as observation, enables us, also, to know that the habitual, is safer than the interrupted, use of tobacco; so, only, there be no excess. The insusceptibility, which the continued use establishes, soon passes off on suspending the influence, and leaves the individual more or less liable to nauseating and other morbific effects, on resuming the luxury. If this be often repeated, it would probably lead to chronic or other forms of disease (§ 535, &c.).

There is, therefore, a remarkable difference between the ultimate effects of the habitual use of tobacco and of most other poisonous agents of the Materia Medica. The narcotics, for example, are constantly morbific, while continued in their moderate therapeutical dose, though less so by use than at the beginning. But this is not true of many of the ordinary causes of disease, which observe a coincidence with the effects that arise from the habitual and interrupted use of tobacco. The miasmata which lay the foundation of fever are examples (§ 544, 550, 551, 552 *a*). This brings into view the differences in the vital constitution of different parts of the mucous system, and the examples are clear illustrations of those distinctions; since, in the case of the poisonous agents of the Materia Medica (including tobacco), they exert their influences upon the mucous tissue of the stomach and intestine, while tobacco, as a luxury, and miasmatic agents, are mostly operative upon other parts. The same is seen in the skin, since tobacco will not establish the habit of endurance in that organ (§ 136, 137 *b*, &c.). Tobacco is also another witness, in its associated aspects as a luxury and as a poison, against the doctrine of operation by absorption.

remedy of the whole Materia Medica." "Its good effects are not, as is the case with some valuable medicines, remote and contingent, but they are immediate, direct, and obvious; and its operation is not attended with pain or discomfort. Furthermore, it is applied, and with the greatest success, to the relief of maladies of every day's occurrence, some of which are attended with the most acute human suffering. These circumstances, with others not necessary here to enumerate, conspire to give to opium an interest *not possessed by any other article of the Materia Medica;*"—and certainly not by bloodletting.

And now suppose that the Author of these Institutes had made the same affirmation of opium, instead of having bestowed the like commendation upon bloodletting in his former work; he would have cheerfully acquiesced even in the misrepresentations of his *Commentaries* by the British Medical Press, and in the countenance afforded by the British Medical Profession of the great injustice inflicted upon himself, as an atonement for the injury he might have done.—NOTE W p. 1127.

Nor did I scarcely do justice to the cause which I endeavor to advocate, when, in a former section, I spoke of the influence of the British "Association" in their concerted action to overthrow the fabric of Medicine, and to raise upon its ruins the absurdities of a foreign Chemist (§ 349, *d*). The record should have been also made that the work on "*Organic Chemistry applied to Physiology*" had been a year before the Profession, ere its successor, the work on "*Animal Chemistry applied to Pathology and Therapeutics,*" was "*communicated to the British Association for the Advancement of Science,*" and "*Edited* FROM THE AUTHOR'S MANUSCRIPT, BY WILLIAM GREGORY, M.D., PROFESSOR OF MEDICINE *in the University and King's College,*" and before other distinguished British medical writers became the systematic INTERPRETERS of the Author's *meaning*, as well as Champions of his doctrines (§ 350½, 350⅔, 447½ *f*). The hurricane, I say, swept over the Nation, and such was its force upon the Continent, and even in America, that the learned in those Countries had serious doubts of the stability of any science, and that the great bulwarks, which had been slowly and progressively reared by the observation and wisdom of a long series of ages, would be, hereafter, at the mercy of any aspirant. For all this, the British Nation must and will be held responsible (§ 1062½–1065, 1068, *a*.)

And now, let us remember, that when radical and enduring changes may be wrought in any science which is built upon the foundations of Nature, and when, especially, the phenomena have been open to all, they will hereafter advance as slowly, at least, as the errors had sprung into existence. The wisdom of one generation is, at most, but a shadow in advance of the last; and, however discoveries may come up in the open field of Nature, the great laws which have been educed from what was known in the past will be of no easy subversion. Nor can I doubt, that come what may to Medicine, we shall sooner or later go back to Hippocrates, and begin a reconstruction upon the foundations which his genius and observation had laid (376½, 376¾).

Developments of important facts in science and in art may advance with rapidity; but, even those details, which are apt to grow out of principles already known, are commonly progressive according to the sum of knowledge which may be handed over by one generation to the next succeeding. It is not, however, equally true, that a portion,

or the whole of mankind, relapse into ignorance, speculation, and superstition, through the same gradual process. The decline of the Roman Empire, and the subsequent darkness which overshadowed the earth for six hundred years, or the later fall of Spain from the highest to the lowest rank among the nations of Europe, are a melancholy commentary upon the rapid and disastrous influences of luxurious ease, and arbitrary opinion, upon knowledge and philosophy, and illustrate the tardy pace of the human mind in regaining its independence, recovering the path of Nature, and retrieving what it has lost. Nor is it an improbable conjecture that the serious failure of a harvest in Europe, or any serious impediment to the outlet of British manufactures, or an ascendency of *Puseyism*, would soon place our Ancestor by the side of Spain.

But, practical examples in bloodletting are the best demonstrations of the utility of the specific objects contemplated in the present article. I shall therefore supply another, which may be derived from the distinguished Mr. Liston, so able in surgery, and who advises

"*Every practitioner to think twice of the probable and possible effects in every case of disease before he determines upon and proceeds to open a vein for the purpose of draining off the vital fluid.*"

This distinguished surgeon also recommends the use of *aconite* for the cure of erysipelas (§ 892½, *d*). Just now, also (1845), Dr. Fleming (President of the Royal Medical Society of Edinburgh) appears with an able work on the same most destructive agent; and, although agreeing with him, most entirely, as to the value of this remedy in neuralgia, when topically applied, and there be no active inflammation, every consideration of experience is opposed to his declaration, that,

"*Aconite not only effects a cure in a shorter period than any other mode of treatment, in acute rheumatism, but appears to possess the great negative advantage of not increasing the liability to extension of the disease to the membranes of the heart.*"

The great difficulty with bloodletting in acute articular rheumatism has consisted in its too limited application; and if the remedy, as is said, be chargeable with the vice of lighting up the disease in the heart, it is for the foregoing reason (§ 893 *n*, 950, 965, 1000, 1001). Bouillaud is thought to have occasioned no little of this mischief by "copious bloodletting," and mainly because of his expression,—"coup sur coup." But, he rarely ventured beyond a pound or two of blood; and this quantity was made up by successive bleedings,—"coup sur coup." His practice, therefore, was but a feeble resuscitation of that far more successful treatment, in France, by copious abstraction of blood.—(*Med. and Phys. Comm.*, vol. i., p. 325, 326.)

Finally, I hold that the internal use of aconite is inadmissible in all active forms of inflammation, and endangers life under all circumstances of health or disease. Had Dr. Male, of Birmingham, who employed this remedy to the extent of some eighty drops of the tincture in four days, in augmented doses varying from five to ten drops, for the relief of simple, chronic pain in the back, upon the recommendation set forth in the work by Dr. Fleming, been as obviously the victim of bloodletting as he was of the aconite, it can hardly be doubted that such a case would have been marshaled against bloodletting in all forms of disease.—Note H p. 1117.

Nor will I neglect this opportunity of objecting to the proposition

of Dr. Graves, of Dublin, that belladonna, instead of bloodletting, should be employed in those congestive fevers in which cerebral disease is attended by contraction of the pupil, and upon the ground, mainly, that belladonna so affects the brain as to produce a dilatation of the pupil. It is evident, however, that this reasoning is fallacious; for, if belladonna be given in any of the common forms of cerebral disease that disease will be aggravated in proportion as the pupil dilates under the influence of this agent. In justice, also, to the remedy which I advocate, I may say, if its applicability rested on no better foundation, and if, especially, surrounded by the same objections as belladonna, its recommendation would be justly regarded as rash and unphilosophical (§ 469, 476 *c*, 487, 488½, 500 *h*, 569, 892 *d*, 906, motto, *d*).

960, *b*. It may be also difficult to say, whether the mere negative pretext for loss of blood, such as dry cupping, or the substitution of violent internal agents without a plausible apology, or the more common and exclusive dependence upon cathartics, and other acknowledged but minor antiphlogistics, has been most destructive of life. Certain it is, however, that they who most discourage bloodletting are generally the greatest advocates of the violent agents of the Materia Medica. And, it is not a little astonishing with what calm indifference we contemplate the ravages of this unmitigated practice, or the tonic and stimulant treatment of fevers; and more especially when the consequences are alienating multitudes to the soft embraces of homœopathy (§ 857, 878, 893 *n*).—NOTE H p. 1117.

960, *c*. I have already stated my opinion that, among the sequelæ of morbid anatomy as originally taught by the modern Parisian school, and adopted by others, is the system of "*Specialities*;" a name sufficiently significant of its dismemberment of medicine. To this innovation upon a comprehensive science, whose parts can be no more separated, and viewed in the abstract, than any one of the great organs of life can be separated from the rest, and yet go on with its own functions and the residue of the shattered whole with theirs, may be traced up many of the great errors in practice as well as in medical philosophy (§ 129, 137 *e*, 163, 638, 685, 686). That the "*special*" system was an immediate emanation from the hospitals of Paris is evident not only from the natural relations of the pursuits, but from the fact, also, that they sprung up together. Nature thus became disjointed; every thing in disease took on the aspect of materialism; nothing was to be seen but lesions of structure within, and blotches and scabs upon the surface; one kind of fever was located in the liver, another in the spleen, and dropsy in "Bright's disease of the kidneys." Medicine was cut up, in the Parisian hospitals, into numerous fragments, and brought under all the details of the mechanical principle of "a division of labor." Much, however, is owing to an ignorance of the laws of the nervous system in their relations to disease. But, it is also to the same method, in part, that we must ascribe the attempts of a smaller number to substitute tobacco, belladonna, aconite, &c., for bloodletting, in the treatment of inflammation and fever; and it is upon this ground that Magendie was led to imagine that he had produced, in the presence of his class, yellow fever in dogs, and typhus fever in cats (§ 744), and which, especially, has induced many to believe in the matchless virtues of quinia as displayed by Piorry

when he attempted the dislodgment of intermittent fever from an indurated spleen (§ 892, *k*, 892$\frac{4}{5}$ *i*).

960, *d*. But, it is not alone the intrinsic nature of the fundamental evil which has introduced the new system of teaching medicine. There never was a time when so many zealous aspirants were commended to *places* either by clamors, or by the force of industry. The revolution was also only a part of the fashion of the day; and its precipitation harmonized exactly with the achievements in medical chemistry, and other analogous varieties in the wide field of philosophy. Fortunately, this corruption has not yet fastened itself upon the Medical Colleges of Great Britain or America; and the hope may be therefore entertained that the worst of it has passed (§ 1008).

960, *e*. Nor will I leave the foregoing allusions to the comparative value and abuse of the great agents for disease, without referring to the general apathy which is manifested at the havoc which the whole band of empyrics are dealing out with their domestic engines of death; while, were the lancet equally common in their hands, and only now and then a startling slaughter, that solitary result would rouse the indignation of the profession, and disturb the peace of society.

960, *f*. The advocates of bloodletting have sometimes affected its reputation by the mere language in which it is recommended. They are said to be rash; and bloodletting shares the odium. Thus, Dr. Elliotson, in speaking of enteritis, remarks, that "*The first thing one has to do is to bleed the patient well. You must set him upright as he can be, and bleed him from a large orifice without any mercy.*" The prejudiced, or unreflecting, look only at the language; but an upright posture, and a large orifice, render the operation safe, and comparatively mild, though it proceed, as it should, ad deliquium.

960, *g*. I have no doubt that much of the antipathy to bloodletting has grown out of an illusion natural to the fears of man. It is not wholly predicated of debility; for we constantly meet with admonitions against its use in high inflammations, which are not remarkable for their prostrating effect. But, there is nothing more deeply implanted than the knowledge of the immediate importance of the "vital fluid" to the life of every animal; and this conviction has been farther roused into operation by perverting the authority of Holy Writ, that "in the blood is the life thereof;" though, had Scripture said that in Calomel, Jalap, and Emetic Tartar, or Tobacco, Aconite, Lobelia, and Brandreth's Pills, is the death thereof, the quotation would have been hourly apposite. We are, also, dead in a few seconds from the division of a large artery; and we scarcely see a difference in the rapidity of the result when this method, or a division of the medulla oblongata, is employed for the destruction of life. Hence, many come to associate bloodletting, as practiced for the relief of disease, with the extreme method of effecting death. I shall not dwell upon this want of philosophy, but shall only now say, that it is the same defect which leads the objectors to bloodletting in disease to its constant application to pregnant women, and to others dying of apoplexy, or from the shock of a fall, or from drinking cold water, and where there may have been no other inducement for the practice than the capricious desire of the subject, or the prejudice of society. I shall, however, endeavor to indicate still farther the fallacy of the latter practice, and to point out, as it respects disease, some of the principal causes which

modify the necessities of the system in relation to its ordinary supply of blood, and how it sustains the privation by the same contingent influences.

960, *h*. Let us, finally, have a word upon the doctrine laid down and so well understood by Hippocrates, that, "*Severe diseases require severe remedies*" (§ 906, *motto, e*).

From what has been said under the general consideration of Therapeutics, it appears that this rule is to be received in a broad, not a universal, sense (§ 906, *f*). We have seen, for example, that it is remarkably liable to exception in small-pox, &c. This grows out of the nature of the predisposing causes of disease, which alter the properties of life according to the nature of each agent. Each one, as I have said, affects them in *kind*, and in a way peculiar to itself. We have seen this impressively exemplified in the self-limited diseases; and it is shown in the morbific effects of all the agents of the Materia Medica. One will alter the vital states, either in health or disease, more profoundly and more permanently than others. Such, also, is the principle upon which depend the hereditary predispositions to disease. Then we have those dormant changes which constitute the predisposition to idiopathic fever, and which may be in a state of incubation for a year or more before the final explosion.

In all such cases, the properties of life are more or less permanently affected, though not profoundly, till an explosion of more absolute disease shall follow; but often as the result of a long and imperceptible series of morbid changes. In tuberculous phthisis, cancer, syphilis, &c., the properties of life are deeply, as well as more permanently and obstinately affected, and it may be impracticable for art to induce such changes as shall place the diseased states in a recuperative condition; though disorganization may be now the main obstacle.

Then we have the varieties and gradations of febrile and inflammatory diseases, which, according to the nature of the predisposing causes, either yield spontaneously, or submit readily to appropriate remedies, or the force of disease may be too intense for active treatment (§ 961).

Here, too, we derive important lessons from experience, in a more restricted sense, which go with what experience has reduced to principles in respect to the modifying effects of the remote causes of disease, in establishing the principle that the treatment of disease must be governed by the existing pathological states, and with a reference to the nature of the predisposing causes, and that great modifications may be necessary in diseases of a common genus, though all the cases may be distinguished by equal violence, and by many prominent phenomena that may be very analogous. It is now, therefore, that we find the general rule, that "severe diseases require severe remedies," may demand a great modification (§ 52, 137 *d*, *e*, 143 *c*, 150–152, 163, 650, 666, 670, 673, 674 *d*, 675, 685, 686, 847 *g*, 854 *d*, 856 *b*, 857, 858, 859 *b*, 861, 863, 868 *b*, 870 *aa*).

The application of the rule will depend, I say, in a general sense, upon the nature of the remote causes, the organs affected, and the extent in which the restorative principle is impaired. A vast variety of diseases require no aid from art. Others, again, like pneumonia, enteritis, &c., require a prompt and energetic interference. But, again, there are maladies of great violence, as in the examples already mentioned of small-pox, measles, scarlatina, &c., in which the same

treatment cannot be pursued, in a general sense, as in many diseases whose symptoms are much more violent (§ 961, 964, 976, *c*).

It might, therefore, seem that Nature is here contradicting herself. But it is far otherwise. The apparent contradictions are only illustrations of her perfect consistency, and of the great laws that morbific causes alter the nature of the properties and functions of life according to the virtues of each cause, and that artificial impressions can be salutary only in proportion as the morbific causes impair the recuperative principle. But, owing to constitutional peculiarities, and various incidental influences, the disposition to the restorative process in the self limited diseases may be more or less impaired, or inflammation of important organs may supervene, when Nature will require the intervention of art, according to the existing modifications and complications of disease. Again, as in the hot stage of fever, the very recuperative efforts of Nature, if I may say so, are often so excessive as to result in actual increase, or in developments of, disease, and therefore require the interposition of art for a certain degree of restraint (§ 675). These principles will be now illustrated by the effects

Of Bloodletting in the Congestive Forms of Disease.

961, *a*. It often happens that idiopathic fever is attended with venous congestion of one or more important organs; and, as we have seen, it is the tendency of this inflammatory condition of the venous tissue to embarrass the organs of circulation, especially the heart. The same peculiar influences are sometimes witnessed in the inflammations of other tissues; particularly in the advanced stages of phthisis pulmonalis (§ 961, *f*). In all the congestive forms of disease, especially when of an acute nature, the general susceptibility of the system to the loss of blood is increased. I may also say that the prostration which is induced by venous inflammation is quite different from that which results from inflammations of any other tissue (§ 135–137, 140, 150). It is also greatly different from that which attends the cold stage of fever. In the first case, very morbific nervous actions are reflected upon many important organs, and, unless artificially relieved, the powers of life may sink rapidly to a state of extinction. Nature is, as it were, knocked down, and is incapable of a recuperative effort. In the last cases, however, the impression is manifested chiefly in the circulatory system. There is not that profound lesion, in the absence of venous congestion, which prevents the recuperative effort; and hence it probably always happens in pure fever that reaction soon follows the stage of depression (§ 675, 764). Something like the converse of this is seen in those erysipelatous inflammations of the throat which sometimes give rise to an apparently great commotion of the system. But, if there be no great amount of abdominal disease attendant on these cases, the reflex nervous action is expended upon the circulatory apparatus; when any remedy that will relieve the throat will be followed at once by a subsidence of the arterial excitement (§ 140, 927 *b*). But, these cases are apt to be complicated with obscure, though severe congestive disease of the abdominal organs, especially of the liver, which has thrown deeply a morbific predisposition over many other parts, and which, in consequence, feel more profoundly the influences propagated by the intense inflammation of the fauces In such instances, however, the general arterial

excitement is less than in some of the violent affections of the fauces which may be greatly of a local nature, or where any accompanying abdominal disease may be of a different nature from congestion (§ 689 *l*, 973), and according to the nature of the reflex nervous actions.

961, *b*. Venous congestion, independent of fever, is a common form of disease, and manifests the same tendency, as when connected with idiopathic fever, to embarrass the organs of circulation. But, this is only a contingent effect; since the general manifestations of the disease in respect to the circulatory apparatus exist in a subdued form of that excitement which attends the ordinary forms of inflammation (§ 390 *b*, 688 *c–k*, 786, &c., 978). But, when venous congestion becomes suddenly aggravated, or other causes may increase the susceptibility of the system so that the congestive disease may be more sensibly felt in its sympathetic influences, there often takes place a general prostration of the animal functions, and a very impaired condition of the organic, through a peculiarly alterative reflex nervous action.*

It is, however, in congestive fever that we witness the strong demonstrations of venous congestion in generating extensive and profound lesions through its very morbific reflex nervous actions. This is especially true if the local disease exist at the invasion of the constitutional malady. It has then already shed a malign influence in connection with the predisposition to the general disease; and, as these influences progress together, they come in with intense force when the explosion takes place, and, unless art should now interpose, the diseases go on mutually exasperating each other, and calling into existence other congestions, or inflammations, which make all haste to join in the circles of disordered movements (§ 143, 514 *h*, 666, 902 *g*). The presence of venous congestion not only aggravates the constitutional disease, but, in itself, modifies the *nature* of that affection for the worse (§ 786, &c.), prolongs the stage of intense morbid action (§ 764, *a*), often prevents the succession of the hot stage, and does its own peculiar part in overthrowing the organic functions; often exerting its malign influence till subdued by art (§ 927). Here, too, it is that art must make its demands upon science more extensively, more deeply, than in any other conditions of disease. The proper management of bloodletting, cathartics, &c., or whether a stimulant shall be first administered, or whether under the most appalling aspects of the combined force of disease we shall leave all to Nature till she will admit of help, are often problems upon which life is poising at the moment, and can be resolved only by the enlightened physician.

But, it commonly happens that remedial aid may be promptly and efficiently administered; and, it will be my purpose, therefore, to indicate that system of treatment which is demanded in a vast proportion of the cases (§ 1056, 1068, *a*).

As a preliminary step, I must refer the reader to what I have said of the pathology of venous congestion (§ 786–818), and especially to the *Medical and Physiological Commentaries*, for the proof of the inflammatory nature of venous congestion, and its dire effects upon organic life. It is also important to add, in this place, that although there exist more or less apparent prostration of life in the aggravated conditions of venous congestion, and of active phlebitis, as, also, in congestive fever, the term is here employed in a conventional sense, and not as significant of debility, or of any necessary depression of

* The blood often gravitates from congested veins after death, especially of the liver, leading to a false conclusion that there had been no such affection (§ 699 *c*, 800).

vital action. The circulatory organs are, indeed, often more or less sunken in their action; but the immediate instruments by which the morbid processes are carried on are actually exalted in their organic properties. These properties, too, are now greatly diverted from their natural state; and it is that alteration in *kind* which essentially constitutes the local condition of disease, and from which arise its morbific reflex influences, and it is this, and the partial loss of voluntary control over the muscles of animal life, which have led to the doctrine of *debility* (§ 410, 476 *c*, 487 *h*, 500 *h*, 569, 639, 743, 746, 780, 915–921, 999 *b*).—NOTE Ff p, 1135.

961, *c*. In consequence of the foregoing morbid state, the sudden abstraction of two or four ounces of blood, in congestive fevers, uterine phlebitis, &c., will often produce syncope. But, where the complications consist of the ordinary forms of inflammation and venous congestion a greater loss of blood will be sustained at its first abstraction; though generally less than when the same inflammation is unattended with congestion (§ 137 *d*, 140, 476½ *h*, 803, 804, 806, 973).

961, *d*. In the foregoing cases a small loss of blood will frequently create a greater tolerance of the remedy; especially if syncope supervene. It happens, therefore, in numerous cases, that we may proceed, soon afterward, to abstract sixteen to forty ounces without producing syncope. The first impression on the organic properties so modifies their condition and lessens their susceptibility, and mitigates the force of disease, and releases the embarrassed circulation, that the subsequent and greater loss of blood often fails of producing any powerful influence, unless carried to a pretty large extent. Dr. Burnett, in describing the congestive fevers of the Mediterranean, says, "it will often happen, after a few ounces of blood have flowed, that syncope will be induced. But, in the course of an hour the bleeding may generally be repeated, and thirty or forty ounces may be taken away without producing syncope." Such has been often my experience.

961, *e*. In cases of the foregoing nature there is more or less determination of blood from the circumference, and its consequent accumulation about the right cavities of the heart, by which this organ is embarrassed in its action, generally contributes to the early syncope. Among the results of the vital change effected in the capillary vessels by a small loss of blood is their immediate expansion, and a returning equilibrium of the circulation. It is true that loss of blood, by increasing the contraction of the capillary vessels, increases, also, the determination of blood upon the heart; and it is in part, as I have said, for this reason, that a small loss of blood often overpowers the circulatory organs. But, when syncope passes away, this state of the circulation, and other morbid phenomena, will have been more or less subdued. The influence of loss of blood which results, as a primary effect, in increasing, or producing a contraction of the capillary blood-vessels, is so essentially different from that of the morbific cause which determines, apparently, the same phenomenon in the cold stage of fever, as in the analogous conditions of venous congestion, that it alters the morbid state, and thus places the vessels in a way to undergo an active expansion; or reaction, as it is called. And herein we witness a critical instance of the alterative nature of loss of blood, and how its influences are exerted, and how apparently the same phenomenon is not the same, and may be, therefore, due to even opposite causes (§ 150–152, 650, 1039, 1040, 1056, 944 *c*, 954 *d*).

961, *f*. We sometimes observe a similar prostration of the circulatory organs from acute inflammation, when attended with pain, especially of the intestines. Here, too, is the same inability at first to bear the loss of blood, and the same tolerance created by its abstraction (§ 961, *a*). Thus, Dr. Wardrop: "A gentleman was seized with acute pains in his bowels, accompanied with a good deal of tenderness on slight pressure, along with some degree of febrile excitement. On opening a vein in his arm, only a few ounces of blood were removed, when the pulse sank and he fainted. In two hours afterward I bled him again, and he did not fall into a state of syncope until he had lost about thirty ounces of blood" (p. 79, Note as to *pain*).

Many examples of the foregoing nature occur in the "*Commentaries.*"

962. When syncope is produced by a small loss of blood, and by the loss alone (§ 938), and where this remedy is demanded, the disease is serious, and will probably require one or more prompt repetitions of general bloodletting. Nothing short of this treatment will be likely to subdue the obstinate venous congestions which are the usual cause of the prostration of the system, and of the intensity of the febrile force, if complicated with this constitutional form of disease.

963. If mental causes, or intestinal irritation, have contributed to early syncope, we may generally proceed to the farther abstraction of blood soon after the patient revives, which, in the cases now under consideration, is commonly important (§ 937). If loss of blood, alone, have been the cause of the early paroxysm, a longer interval (four, six, or eight hours) may be most expedient, or necessary (§ 794, 795, 801). The state of nervous influence decides the whole.

964, *a*. In the cases now supposed, the prostration is sometimes so great that it may be necessary to create a tolerance of loss of blood by previous stimulation, or before resorting to the repetition of bloodletting (§ 961, *b*). And here, too, enlightened experience abounds in the records of medicine. Thus:

"Immediately upon the application of warmth to the surface," says Dr. Gallup, "take a little blood; perhaps two, four, six, or eight ounces, according as the patient may bear it. If he be a little faint, it is nothing but what is common; a little time will remove it. He will soon bear a second bleeding in this condition better than the first."

Aretæus not only describes this condition of disease, but advises the same enlightened practice, especially if the congestion be the occasion of great prostration and "syncope." "Venas itaque in cubito protinus cædito, multumque sanguinis, sed non semel totum mittito; imo, et bis, et ter, alio die, *quo interim* vires *instaurentur* repitito." Alexander of Tralles discourses in the same manner upon this subject. The language of A. Paré is remarkably graphic in describing the treatment of the Plague and "Pestilent Diseases." It corresponds with the best philosophy of our own day.

"So soon," he says, "as the heart is strengthened and corroborated with cordials and antidotes, we must come to phlebotomy and purging." "You may perceive that the patient is ready to swoon when that his forehead waxeth moist with a small sweat suddenly arising, by the aching or pain at the stomach, with an appetite to vomit, and desire to go to stool, gaping, blackness of the lips, and sudden alteration of the face into paleness, and, lastly, most certainly by a small and slow

pulse: and then you must lay your finger on the vein, and stop it until the patient come to himself again, either by nature, or else restored by art; that is to say, by giving him wine, or any such like thing: then, if you have not taken blood enough, you must let it go again, and bleed so much as the greatness of the disease or the strength of the patient will require or permit" (§ 892⅘, *i*).

964, *b*. No injury can grow out of the use of stimulants in these cases while the powers and actions of life are so morbidly affected as to be still more injured by the loss of a small quantity of blood. In these cases; bloodletting, without previous stimulation, impairs still farther the vires vitæ, which are now too morbid to react under its influence, and it increases, permanently, the determination of blood from the circumference to the centre.

964, *c*. In other cases like the foregoing disease is so intense at its invasion, and Nature so little recuperative, that it may be impossible to create a tolerance of loss of blood. No reaction appears in these cases, and all such patients must perish (§ 149, 150, 794, 795, 801, 808 *b*). Nothing will rouse an exciting reflex nervous action.

964, *d*. At other times, even in the active forms of inflammation, the power of the system to bear the loss of blood may be destroyed by other remedies. Thus, it frequently happens in croup, that emetics, especially of tartarized antimony, render bloodletting impracticable, particularly when they produce catharsis instead of vomiting; and the patients may then die from their inability to sustain the necessary loss of blood. Thence appears the importance of carefully considering their relative order in the administration of remedies, especially where loss of blood may be essential. I am certain, from observation, that bloodletting has lost its reputation, with some, in pneumonia, &c., from its having been applied unsuccessfully under the prostrating influence of tartarized antimony, and when, in consequence, the powers of the system would only admit of a moderate loss of blood, and would not bear the superadded depressing nervous action.

965, *a*. Dr. M. Hall, and some other writers, suppose that the power of the system to bear an increased loss of blood is owing to an increase of disease; which appears to me an important practical error. On the contrary, the first bloodletting generally diminishes the activity of inflammation, however it may subsequently acquire its original or greater force. It is true that an increase of inflammation will act in the manner supposed; but it does not thence follow that there has been an increase of disease in other cases because the patient bears a second better than the first bloodletting. Indeed, in the cases now before us an increase of the venous congestion after the first bloodletting often diminishes the tolerance of loss of blood, on account of the peculiar influences of that form of disease. This, too, is especially apt to occur where the abstraction of blood has been inadequate to the exigencies of the case; and these cases, in consequence, have brought great disrepute upon the remedy, though it be the only practice that supplies a chance of relief.

965, *b*. When too little blood has been abstracted for the exigencies of the disease, although frequently repeated, it may increase the force of the malady. Inadequate depletion so modifies the organic powers that it rouses them into greater energy; the whole circulation becomes released from its embarrassment in the capillary system;

and the heart being thus, and in other ways, set at liberty and invigorated in force, propels the blood with increasing violence. This mechanical influence, in itself, lights up the flame of disease, and kindles it in other parts already disposed to join in the disordered movements. But much is also due to an augmented irritability of the instruments of action; when irritability would probably have been lessened by a greater loss of blood. The effect produced by the smaller loss, in rousing and otherwise modifying the general capillary action, reflects a stimulatiug nervous influence upon the immediate instruments of the local malady, which, in its turn, had equally sustained, in the more direct manner, an exalted state of action; and thus are instituted circles of reacting sympathy between the general and local capillary vessels (§ 982–1003). The same results, it is true, with the exception of the morbific, attend the loss of blood when carried to the extent of its curative influences (§ 961 *d*, 966, 994 *b*, 1005 *e*). The remedy, therefore, in all grave visceral congestions, as well as in inflammations, should reach the point of absolute depression. The powers of life are then not only subdued in energy, but the strength of the impression places them in the way of the recuperative process (§ 961 *e*, 1056, 1068).*—Notes Ee p. 1133, Ff p. 1135, Gg p. 1138, Ll.

966. Leeching is absolutely inadmissible in the foregoing forms of disease. It is now a great object to relieve the heart of its morbid sympathies with the capillary system, and of the accumulated blood, and thus establish something like an equilibrium in the organs of circulation. But, since it is the primary effect of loss of blood to produce a contraction of the capillary vessels, and to thus determine an unusual volume of blood upon the centre of circulation, that mode of bloodletting should obtain which is least obnoxious to these objections (§ 921). This is general bloodletting; and although it increase the general contraction of the small vessels, its impression is then so rapid that it more or less subverts, with a corresponding instantaneousness, their morbid state. An immediate dilatation of the vessels is the consequence, the blood circulates with greater freedom, and thus the heart is enabled to throw off the accumulated blood; while the favorable change induced in the extreme vessels moderates or removes their depressing reflex nervous action, by which the heart is farther roused into increased energy (§ 921, 934, 944 *c*, 965 *b*).

967. The prostration of which I have spoken in this division of my subject is commonly mistaken for debility (§ 469, 476 *c*, 487 *h*, 488½, 500 *h*, 569). Stimulants are therefore too apt to usurp the place of bloodletting and other analogous means, and to occasion a frightful mortality. On the contrary, there should be no delay of that decisive use of the *remedium principale* which may be demanded by the exigencies of the case. Seize the first moment that nature is ready, should any preliminary steps be required (§ 964, *a*), or she will soon advance to a more forbidding state, and baffle the well-directed efforts of art (§ 863, *d*, 999 *c*–1007, 1019).—Notes Ee p. 1133, Ff p. 1135, Ii.

968. Since, therefore, it is always important to do as much as may be requisite, and as nature may admit, at the early stages of disease requiring the loss of blood, we must not be deterred by early syncope from early attempts to abstract the quantity of blood which the exigencies of the case may seem to demand. It is astonishing how soon, in congestive fevers, the morbid powers of life will rally under the

* It is a paradox to most that a large loss of blood may be curative when a smaller would be fatal, but the former perhaps unnecessary to life (§ 1001, 1005 *g*).

loss of a few ounces of blood, and how soon we may subsequently proceed to a more decisive use of the remedy.

969, *a*. Where venous congestion is associated with idiopathic fever, and the stage of reaction appertaining to the constitutional disease has come on, the prostrating influence of loss of blood is vastly lessened, and far greater quantities are often borne at its first abstraction; and this especially, as will appear in the next following division of our subject, if some active form of inflammation be also attendant; though even now it oftener happens that a second bloodletting is better sustained than the first. In all these cases the several forms of disease constantly interchange modifying reflex nervous actions, and these modifications are as constantly varying, either spontaneously or through the operation of foreign causes.

969, *b*. It will appear, also, that simple venous congestion of the brain sometimes manifests a strong exciting influence upon the organs of circulation; when bloodletting is borne, at its first application, to an extent which never obtains under the usual depressing influence of the disease (§ 688 *c–f*, *k*, 806, 978).

969, *c*. Although it be generally true that it is the tendency of venous inflammation, whether in its active form, as in phlebitis, or in its sub-active, as in venous congestion, to depress the general circulation, and, when the latter is attendant on idiopathic fever to delay the stage of reaction, and that it is the usual effect of loss of blood to increase that depression, progressively, till syncope comes on, there are, nevertheless, numerous instances in which the remedy manifests an opposite effect. That is to say, relief may be so instantaneous that the pulse will increase in volume and force, the dark and trickling blood spout out with a florid hue after a few ounces have escaped, and while still flowing from the arm.* In these cases the abstraction of blood should be continued till the pulse is again subdued, or the necessary impression will not be produced (§ 806, 1056).

969, *d*. So variable in intensity are the morbid changes in the different varieties of congestive fever, especially the local congestions, as in the plague, yellow fever, typhus, &c., at different times, that an impression exists with many that those diseases must be treated at one time with stimulants, while bloodletting may be necessary at another. But this is neither true nor philosophical. On the contrary, since the same disease is always essentially the same (or there is an end to all medical philosophy, § 752, &c.); and since also disease is most intense and malignant where bloodletting is, at first, most imperfectly borne, if this agent be important in the mild forms, it is more so where the prostration, and, therefore, the amount of disease, is greatest. This, too, is universally sustained by all the best experience (§ 1005. Also, p. 868–872, § 1068).—NOTES FF p. 1135, KK.

970, *a*. Cases not unfrequently occur which present many of the phenomena of the prostrated conditions of venous congestion, and congestive fever, which have no affinity with those diseases, but which are constantly confounded with them. Such is the case with injuries from falls, the shock of surgical operations, &c. Here the powers of life are actually and simply reduced; certainly not modified as by the action of specific morbific causes (§ 790 *b*, 961 *b*).

970, *b*. In the latter instances the abstraction of blood has been often fatal, and should never be practiced unless some inflammation

* See KRIEMER's experiment p. 310, § 485.

subsequently spring up. But if the prostrating nervous influence be great, even though the brain have sustained concussion, stimulants should be administered. This should also be the practice in the analogous conditions which are produced by drinking cold water when in an excited state from the united effect of hard labor and hot weather. Opiates should be also employed to relieve the stomach. In apoplexies, when the pulse is sunken bloodletting should be delayed, or cautiously practiced at first. The morbid state of the brain, or pressure on the organ, has determined, in such cases, a perniciously depressing influence on all the powers of life, and the impression from loss of blood superadded to this morbid influence may destroy the patient at once. Bloodletting will be ultimately necessary, and perhaps to a large extent. It commonly happens, however, that an opposite or exciting nervous influence is determined upon the heart and capillary vessels, at the invasion of apoplexy; that the pulse is full and bounding, the face flushed, &c. In these cases, decisive bloodletting, cathartics, &c., are the principal remedies.—(*Med. and Phys. Comm.*, vol. i., p. 342–361; vol. ii., p. 234–238.)

970, *c*. There are many sympathetic affections supervening on congestive disease of the abdominal organs which appear to most observers to be the leading condition of disease; such as diffuse inflammation of the mucous tissue of the fauces, erysipelas, painful affections of the head, &c. These, however, as I have before said, should be considered rather in the light of symptoms, while the essential means of cure should be directed to the primary and principal seat of disease (§ 689, *l*). In the cases supposed, many different tissues may be affected, and there may be, also, much variety in the morbid states. There is congestion (sub-inflammation) of the venous tissue of the liver, &c., more active inflammation of the fauces, or of the skin. But, the mucous tissue of the stomach, and intestines, is also more or less severely affected, and the head suffers sympathetically. These last conditions, however, are not inflammatory, perhaps; but so nearly approximate that pathological state that they are readily converted into it by any increasing force of hepatic congestion (§ 803), by the undue irritation of cathartics, or by improper food, stimulants, &c. (§ 527 *d*, 528, 529). All other parts suffer, also, more or less, in their vital states; and, although variously, there is yet determined throughout, by the leading conditions of disease, a general coincidence between the morbid states that may be strongly pronounced and those which are less so, and where predisposition is only taking place (§ 143 *c*, 150–152, 870 *aa*). This may be more distinctly appreciated by referring to what I have said of the influences of remote causes (§ 630 *c*, 652, 657 *a*, 659, 689 *l*, 694¾, 813, 817, 847 *g*, 1058 *m*).

I am now brought to the application of the foregoing remarks. We see, therefore, from the analogy which prevails throughout the morbid states, how a single remedy, like loss of blood, will strike a blow at any one of the pathological conditions; and the more profound its influence upon the principal, the more completely will it subvert the minor affections. But loss of blood is far from being always necessary in these complex conditions; and we may then find that some internal remedy, as, for example, a compound of six or eight grains of the submuriate of mercury, twelve or twenty of jalap, and one to five of ipecacuanha, will stretch its power to every part of

the organism, touch every part with a corresponding salutary influence, and start every part at once on the way of recuperation (§ 143, 233⅘, 514, 674 *d*, 733, 804, 811, 847 *g*, 1056, 1059).

The foregoing example is also a good illustration of an important doctrine which I have propounded to explain what humoralism had neglected; the exemption of all parts of the body from any deleterious action of the blood in those local forms of disease which are capable of modifying its character. The blood is always affected in nearly one universal way in any given condition of disease; whatever the sympathetic complexities. The whole condition of the solids, from the highest to the lowest grade of disease, moves on under reciprocal harmonizing influences of all parts upon each other, though the greater malady exert a controlling power. The morbid blood, therefore, is exactly adapted in its condition to all parts, and, therefore, molests none (§ 137 *e*, 143 *c*, 847, 870 *aa*, 984).

Of Bloodletting in the recognized Forms of Inflammation.

971. Although I have demonstrated in my Essay on Venous Congestion, contained in the *Medical and Physiological Commentaries*, that its pathological state is constituted by inflammation of the venous tissue, the subject, notwithstanding its importance, has received as yet but little attention from the hands of others; but stimulants, as usual, especially in Great Britain and France, continue to be the favorite means of treatment; though not so, nor ever so, in these United States. The decision of the right still rests with futurity; but that future, in the prospective view of America, in the rise of the North of Europe, and the retrospective view of Southern Europe, cannot be distant.*

972. I now approach, however, conditions of disease which have been, from immemorial time, of an admitted inflammatory nature; however various the hypotheses as to their pathological cause. We now lose sight, or mostly so, of that depressing influence of venous congestion which so often gives malignancy to fever, and embarrasses or disarms the hand of art, and are in the midst of innumerable modifications of the same pathological state as presented by other tissues, that reflect upon the system a series of different influences, though often of an intensely morbific nature (§ 935, *d*).

973, *a*. To comprehend fully the effects of loss of blood in the inflammatory conditions now before us, it is still important to bear in mind the reciprocal sympathies among the capillary vessels of all parts and with the heart, as set forth in the preceding divisions of our subject, since upon them depend, as in simple forms of venous congestion and active phlebitis, the disturbing reflex nervous influences of all local inflammations. But these constitutional results, although dependent upon reflex actions of the nervous system as when they spring from venous congestion and active phlebitis, present an aspect more or less different. The local conditions exalt, instead of depressing, the general action of the circulatory organs. There is an expanded, instead of a contracted state, of the general capillary system; the circulation is free, the heart unincumbered with accumulated blood, and beats with more than its natural vigor and frequency. These inflammations, therefore, commonly act upon the system at large after the manner of direct stimulants, and thus tend to counteract the depressing effect of loss of blood (§ 226, 229, 500 *m*).

* The stimulating treatment of all diseases has become very general in the U. S. A. —Notes F p. 1114, H p. 1117, Ee p. 1133, Ff p. 1135, Mm p. 1141.—1865.

973 *b*. The point, therefore, to be now observed is an apparently opposite effect of reflex nervous action, excited by inflammation, upon the organs of circulation from that which attends the loss of blood or any other sedative agent. One is exciting, the other depressing. One excites general arterial action, the other subdues it.

974, *a*. Certain parts, under equal degrees of common inflammation, maintain the general exciting influence upon the organs of circulation against the depressing effects of bloodletting more than others, and this is especially true of the brain (§ 230). In many forms, also, of specific inflammation, as in acute rheumatism, the local vessels are in a peculiarly irritable state, and produce an excessive exciting influence upon the whole sanguiferous system; the heart itself often participating, by sympathy, in the rheumatic inflammation (§ 525, 526 *b*, 527). Something in this respect is also due to the nature of the tissue which may be the seat of the affection; articular rheumatism, for example, deriving an obstinate character from the peculiar vital constitution of the ligaments (§ 133, 134). Here the affection may yield only to great losses of blood; especially if the chief dependence be placed upon this remedy. Owing to the same persistence of local disease, and its general influences, cathartics make less impression than in most other active inflammations, unless of the brain. For the same reasons, also, gradually-increased doses of the antimonials are commonly borne to a large extent, and vascular action yields slowly to their influence. A common principle is concerned with all the remedies, according to their developments of reflex nervous action.

974, *b*. On the other hand, when inflammation, in rare instances, is aggravated or induced by an excessive loss of blood, such is the combined nature of the exciting cause and its curative effects, that the modified irritability of the vessels may readily yield, at the moment, to a farther loss; but if general bloodletting be now practiced, it will soon go on with its deleterious influence (§ 950).

974, *c*. Inflammation of the brain develops very powerfully and obstinately an exciting nervous influence, which not only holds in subjection, against the usual influence of loss of blood, the whole capillary system and the heart, but this nervous power is determined upon the vascular system of the brain itself with greater intensity than upon the instruments of inflammation in any other part (§ 227, no. 1, 230). Hence it is, that general bloodletting is commonly necessary to a greater extent in inflammations of the brain than of other organs. This is the reason, also, why general bloodletting is required by the cerebral inflammations and congestions of infants, when leeching will often succeed in inflammations of equal intensity in other parts at that period of life (§ 576 *e*, 925 *b*, *c*, 951 *b*, *d*, 955, 992, 944 *c*, 1056).*

975, *a*. Again, another general law. So great is the sympathy between vessels of the same order, and especially those in which the organic properties are most active, that while those which are engaged in the process of inflammation remain unsubdued the whole series throughout the body is liable to be thus held in a state of excitement. This is peculiarly true when the brain is the seat of inflammation; for, while the contraction of its capillaries tends, as a sedative, to prostrate the general circulation, their morbid excitement, on the other hand, not only contributes to sustain the general circulation, but the influence of a stimulant is, by this cause, still exerted upon the organ,

* See NOTE Q p. 1122.

and still propagated to the heart and arteries (§ 226, 229, 230, 480–483, 500, 526 *a*, 916–921, 929–936). The excitement of the vessels of the brain is partly promoted by their peculiar relation to the organ which is the principal centre of the nervous power, and in part by the tendency of that condition to prevent a contraction of the corresponding vessels in other parts. This peculiarity depends upon a special nervous influence which is exerted upon the vessels of the brain in a state of inflammation (§ 231), and is thus distinguished from that condition of the vessels in other parts when the seat of inflammation. In inflammations of other organs, therefore, the nervous influence by which excited vessels hold in partial subjection the corresponding series throughout the body is less, and is sooner overcome by loss of blood, and general prostration follows sooner, than when the brain is the seat of inflammation (§ 140, 1039, 1040).—Note Hh p. 1138.

975, *b*. Hence the reason why greater loss of blood is generally necessary in cerebral inflammations to produce syncope than in similar affections of other parts. In the latter cases, and where general bloodletting is used, the capillaries of the brain are brought under impression as soon as the loss is felt by the instruments of disease; and the depressing nervous influence then becomes a powerful co-operating cause of the general prostration (§ 930–934, 940–942). But, it is now obvious, that when the brain is the seat of inflammation this influence is obtained with greater difficulty. Before it can be established by loss of blood a positive change in its highly-excited capillaries must be effected, and that opposite state of nervous influence which arises from their excitement must be first overcome (§ 944 *c*). This depression may be often obtained most perfectly, and propagated most extensively, by long-continued syncope. This will sometimes happen in most inflammations of other parts, and sometimes of the brain itself, by the loss of small quantities of blood (§ 951 *b*, 955 *b*, 1056).—Also p. 920 Note.

975, *c*. We learn from the foregoing philosophy the reason why, in cerebral inflammations, there is oftener a rise of inflammation after syncope from loss of blood, than in inflammations of other parts. But, in all the cases, if a repetition of the remedy be required, the same influences will, in a general sense, operate again, and again enable us to abstract all the blood that may be salutary at the next operation; and so on, till a permanently salutary change is established.*

976, *a*. Again, in certain diseases where the cerebral and ganglionic systems appear to be much involved, but in an unknown manner, and where, perhaps, there are no special marks of inflammation in any part of the body, vast quantities of blood may be lost without inducing syncope. In these cases there is great nervous irritability. I have seen upward of thirty ounces of blood taken from the arm of a man, in hydrophobia, after the radial artery had ceased to be felt; the patient being all the while in an erect posture, and remaining to the last without any sense of faintness. Similar cases are recorded by the East India surgeons.

976, *b*. On the other hand, we have an opposite state of the cerebral influence in some cases of mania, and the delirium of drunkenness, where, from its depressing effect, the condition of the system has been erroneously compared to that of debility (§ 569, *d*). In some particular cases bloodletting is imperfectly borne; evidently from its strong impression upon the nervous centres. In the case of drunk-

* See Note Ccc p. 1148.

enness there is venous congestion of the brain, and so modified by the remote causes as to often lead to early syncope (§ 816 *b*, 978).

976, *c*. Analogous modifications will also arise from any peculiar manner in which the organic properties of other parts may happen to be affected; not only in specific inflammations, but from those shades of difference which attend common inflammation (§ 652 *c*, 722). Particular influences will be determined upon the whole system by these modifications, according to the nature of the combined influences transmitted to the nervous centres, by the exact modification of disease and the special influences it may exert on other parts, and give a corresponding direction to loss of blood (§ 150, 151, 228, 500, 514 *h*). Thence it will appear that much will depend upon the natural relation of other organs to the nervous centres, and to other parts of the body, and the special vital constitution of each (§ 133–138, 143–152).

Other, and more accidental causes, may contribute to these results. They have all an important bearing upon the effects of loss of blood, often playing an important part in the phenomena of bloodletting; leading to syncope from the loss of an ounce of blood where we may have calculated upon a pound or more, or where yet more may be demanded by the exigencies of the case. The effect, therefore, of loss of blood may throw, at once, a flood of light upon some obscure condition of disease, as some ill-defined venous congestion, or upon some natural peculiarities of constitution, &c. Or, again, it may be useless, or hazardous, to bleed a patient far advanced in typhoid pneumonia, or in the pleurisy of confirmed phthisis, or in less serious inflammations incident to the scrofulous diathesis, or in the phlegmatic temperament.

It is therefore manifest, that peculiar impressions will be determined upon the nervous centres by the loss of blood, and thence reflected with varying effects upon other parts, according to the natural constitution of each individual, the nature, extent, force, duration, and organic lesions of disease, the organs affected, especially if the brain be its seat or otherwise participate, and according to the nature and extent of the cerebral derangement, and the nervous influence which may be exerted by this and by other parts (150, 151, 892$\frac{4}{5}$ *i*, 1008).

977. But it cannot be too strongly urged, that in abstracting blood, and in the administration of cathartics, emetics, antimonial alteratives, &c., it should be considered that it is the constant tendency of an inflamed part to prevent a contraction of the capillaries of other parts, and therefore to maintain the action of the general circulatory system (§ 933, 944 *c*). We shall not obtain a proper amount of this general impression, if important to the case, until the loss of blood is sensibly felt by the part inflamed; and this may depend upon a great variety of circumstances, even upon the contingency of a large or small stream of blood, the posture of the subject, the state of his mind, &c. But, in all severe inflammations the general impression should be fully produced, and this is only effected at, or near the point of syncope; the patient being always in a sitting or elevated posture.

978. Although, as we have seen, it is the tendency of venous congestion to depress the powers of circulation, there are many chronic cases of this disease in which the law relative to inflammation of other tissues is found to obtain, though in an inferior degree. The pulse is more or less excited and hard, and loss of blood is more or less borne, at the beginning of the treatment, as in the other cases. This

is especially true not only of chronic, but of the more rapid form of the disease, when affecting the brain. The chronic conditions, however, sometimes become suddenly aggravated, and the general circulation sinks down suddenly under this aggravated state, when syncope may follow a small abstraction of blood (§ 688 *c–k*, 786, &c., 976 *b*).

979. From the foregoing considerations it appears that general bloodletting is the great remedy for all inflammatory affections of important organs, with those exceptions of a chronic nature to which leeching is more appropriate, and which occur in that division of our subject for the purpose of illustrating its philosophy (§ 914, &c.). There should be no hesitation, in the active forms of this disease, with the most cautious practitioner, in meting out a full measure of the capital remedy. The tendency of the affection to sustain the system under the loss of blood, and the phenomena of increased excitement, should nerve the weakest arm to an obvious, easy, and important duty. This duty, however, it is my purpose to enforce yet farther, when I shall have reached the experience, and the details of practice, that remain as the choicest legacies of the illustrious dead.—Note Hh p.1138.

980. The foregoing remarks upon the tendency of inflammation to sustain the system under the loss of blood, and the rapidity with which small losses, in venous congestion, will place the organic properties in a state to bear a measure which would prostrate the organs of circulation in health, are farther illustrative of the great law of adaptation, by which nature has contrived all things in organic life for its ever-varying exigencies (§ 143 *c*, 733 *d*, 847 *g*, 870 *aa*).

Of Bloodletting in Simple Continued, and Simple Intermittent Fever.

981. Where fever is not complicated with local congestions and inflammations loss of blood is not often required, unless to reduce the force of arterial excitement when so considerable as to endanger the appearance of those local affections. If this condition, or any condition of the febrile action, do not soon abate under the influence of cathartics, an emetic, and appropriate alteratives, recourse should then be had to general bloodletting; though it will not be often necessary to carry the remedy beyond a moderate extent. If the treatment, however, be early and judiciously begun, the disease will commonly surrender, in its early stage, without the co-operation of the principal remedy for those conditions of fever which are associated with inflammation and venous congestion.

In the cases of high arterial excitement to which I have now referred, it is important to consider that three principal causes are in operation which may lead to the development of inflammations. The most important is the morbid and highly irritable state of the capillary and extreme blood-vessels. The second is the force of the circulation, which contributes, as a mechanical cause acting upon the morbidly susceptible vessels. The third is the augmented volume of blood in those vessels, and whose influence is chiefly that of a vital stimulus (§ 137 *d*, 710 *b*, 784).

982. But, it often happens, as when fever and venous congestion appear in connection, that inflammation presents itself simultaneously with the constitutional malady, or the latter may be preceded by either local form of disease, or these local states may spring up in the progress of the general malady (§ 779, 813). In the last two in-

stances, the affection which is first in order contributes more or less as an exciting cause of the supervening disease (§ 714, 715, 779). If the general disorder then continue to advance, congestions or inflammations of other parts are liable to spring up in quick succession; the general affection, and the local developments, and the predisposition of organs to inflammation or congestion, being the principal causes of the successive explosions of disease, and mutually aggravating each other (§ 137 *d*, 714, 715).

983. From what has been now said, and of the treatment of inflammation and venous congestion, we may make up our minds that there can be no tampering with the complicated forms of fever, whether associated with one or the other of the local conditions of disease. In either case, especially in continued fever, general bloodletting is more imperatively demanded than by either of the local conditions in their independent state; and the earlier this important step is taken the better. Nor should we strike with a sparing hand, nor move at a tardy pace; but rather let the first be a heavy blow, and as oft repeated as the foe may rise, yet always proportioned to its own degree of strength. Let those, however, who may not relish this "rash advice," gather wisdom and moral courage from the experience and philosophy that yet await us from abler hands.

984, *a*. Nevertheless, in the complications of intermittent fever with venous congestion, and sometimes with inflammation, such is the nature of the predisposing cause, and the local affections are so apt to be imbued with its influence, that it frequently happens that bloodletting may fail of the requisite impression upon the local forms of disease, and the special aid of the Peruvian febrifuge, or analogous means, may be useful, or necessary, in subduing the local affections after a due impression has been made by loss of blood, cathartics, &c. In advanced typhus, stimulants, bark, and strong broths are important.

984, *b*. The foregoing reference to the remote causes of disease with a view to some special deviation from the general principles of treatment is exactly on a par with the antidotal treatment of poisons. The quinia, which may be ultimately necessary to overcome intermittent fever, or its associated inflammations and venous congestions, presents a remote resemblance to the elaborate ferruginous mixture in cases of poisoning by hydrocyanic acid, and other analogous examples. It is true, that, in the latter cases the counter-agent acts in a purely chemical manner, while in the former the special agent operates through vital influences alone. I have thus adverted to this analogy in deference to the humoral pathology, and especially on account of a vague belief that quinia cures intermittents by neutralizing the miasmatic poison (§ 662, 809–816, 891½ *k*, 892 *b*, 892½ *v*, 894 *c*, *d*, 1059).

But the whole of this philosophy will be set right by considering the modus operandi of the best antidotes for poisonous doses of opium; namely, coffee and the cold dash. Here there is no difference, in their acceptation as poisons, between the opium and the miasma. Both have equally established their morbific effects.

And now as to the "antidotes for opium." Who ever imagined that coffee removes the morbid states by entering the circulation, and there neutralizing the opium? The modus operandi is the same as I have set forth for opiates in § 891½ *g*, *k*, and for the cold dash and seton in § 514 *d*, 905 *a*. I need not add that the modus operandi of

quinia, in the cure of intermittents, is exactly equivalent to coffee and the cold dash in that of poisoning by opium*(§ 137 *e*, 150–152, 662 *a*, *b*, 892 *b*, *c*, 904 *c*, *d*), and the nervous system will alone explain.

In all such cases, therefore, the special treatment may be considered antidotal; since, as in the cases where we merely attempt to neutralize a poison while it yet exists in the stomach, we equally apply the treatment in the former case to certain specific effects which have resulted from causes which are alike distinguished by very special virtues. In one case we attack the cause itself; in the other, the effects which it may produce.

It is therefore sufficiently evident that in the administration of quinia in the treatment of intermittent fever, and in other analogous examples, we leave, more or less, the general principles which apply to the generic character of the diseases, and turn some agent of special virtues against the modifying influences of such predisposing causes as are capable of bending the general pathology from its more common form. But, it is rare that the general plan of treatment is not more or less in demand; or that the special remedy will come under the law of universal adaptation till the whole system is submitted to influences by such remedies as are consistent with all the varied coexisting pathological conditions (§ 847 *g*, 870 *aa*).

Some other examples of practical importance will, at the same time, advance our philosophy upon the subject under investigation. Thus, bloodletting may, or may not be necessary in a scrofulous inflammation. If it attack the lungs, it will be important; especially in its early and active stages. Here the remedy is of universal adaptation. If the superficial lymphatic glands be the seat of the affection, leeches may be proper. But, in such cases, we are apt to leave the general principles of treatment, and to refer specifically to the nature of the predisposing cause, which is here implanted in the constitution of the individual (§ 561, 586, 659, 661, 666). Experience has shown that iodine, which does not belong to the remedies for common inflammation, is especially adapted to certain states of scrofulous inflammation. But, it is only to subdued forms of the disease that it is suited; while loss of blood is universally applicable in all the active grades of the disease, whatever be the part invaded, and may place every part, and the whole system, in a condition for the salutary effects of iodine (§ 137 *e*, 143 *c*, 150, 151, 163, 870 *aa*, 892 *b*, 892½ *v*).

Again, if the inflammation be syphilitic, and the constitution be invaded by its predisposing influences, bloodletting, cathartics, &c., may or may not be necessary. But, a general antiphlogistic plan should be pursued; at least so far as to exclude stimulating food, which may be all that the case will require (§ 856). In a general sense, however, we should have a more direct reference to the nature of the remote cause, and administer mercurial preparations; since experience has shown this to be the safest and most efficient treatment. Here, then, mercury assumes the character of what is called "a specific" (§ 865, 892 *aa*); though it is one of the antiphlogistics which fall within the principle of general adaptation to inflammatory diseases (§ 662, 859 *b*, 872 *a*, 890½, 892 *b*, *c*, 898, 900, 904 *c*, *d*, 1059).

984, *c*. When speaking of expectorants, and at other times, I have stated the importance of deriving our indications of cure from what we may witness of the results attendant on the recuperative efforts of

* This agrees with the effects of a strong infusion of coffee in health. So, also, Emmert found that coffee increases the violent action of nux vomica (§ 903).

nature (§ 862, 863, 892$\frac{4}{5}$ *i*). I am now led to recur to the subject on account of the great abuse of the principle in the treatment of acute inflammatory affections of the lungs by stimulating expectorants; which are administered for the reason alone that expectoration is one of the consequences of the natural process of cure. On looking a little farther, however, we find that bloody mucus, and pure blood, are often expectorated in pneumonia, and in incipient phthisis; and that hemorrhages are frequently occurring, as the consequence of congestion or inflammation, from all parts of the body. Here, then, is a remedy for inflammations of all parts, suggested by Nature; while expectoration refers to one part only. What is thus inculcated as to the practical application of the more comprehensive principle is enforced by all the most enlightened experience (§ 863, *f*).*

985. Finally, when bloodletting is judiciously practiced, it often supersedes the use of a long train of other remedial agents which may ultimately bring relief, or lessens their number and dose, substitutes the milder for the more energetic, prepares the way for their quick and salutary effects, and saves to the patient much suffering, and secures a speedy convalescence.

Of Bloodletting in the Cold Stage of Fever.

986, *a*. Bloodletting has been practiced successfully by many physicians in the cold stage of intermittent fever. It is not, however, with any reference to this consideration that I have given to the subject the distinction of a chapter by itself; but for the greater purpose of illustrating still farther the influences which are exerted by the loss of blood, and the instrumentality of the nervous system.

986, *b*. That the disease should be thus suddenly arrested is entirely conformable to what I have said of the modus operandi of bloodletting, and goes to confirm the philosophy. The capillaries being then in a state of universal contraction from disease, if loss of blood have its special influences upon the organic properties of these vessels, it should be the effect of such a cause, in suddenly, greatly, and universally increasing that contraction, by alterative reflex nervous influences, so to modify the morbid state as to interrupt the succession of the hot stage. But the abstraction of blood must be carried to the point of syncope, that it may thus determine a powerful nervous influence upon the instruments of the morbid process; or that change will not be established which is necessary to prevent the stage of reaction. In these cases, however, the necessary quantity of blood is commonly small; and syncope, therefore, is easily induced. But, as the morbid contraction depends upon a different cause, and as the vital properties are differently affected from what bloodletting produces, although the remedy occasion the same phenomenon, it often happens that no inconsiderable loss of blood will be sustained before that change can be established in the small vessels which is necessary to perfect the contraction which is incident to bloodletting, and which is the precursor of syncope (§ 1040, 1056, and "contraction" § 944 *c*).

987. How, therefore, shall we interpret by any other philosophy than that which I have propounded the sudden interruption of fever in its cold stage by the loss of a small quantity of blood, when no amount, perhaps, would have arrested the disease if taken at any other period? The quantities, also, necessary to success depend, in part,

* See NOTES F p. 1114, FF p. 1135, GG p. 1138, II p. 1139.

upon the precise period of the cold stage; whether at its beginning, or near its termination in the hot stage. Less is necessary, *cæteris paribus*, in the former than in the latter instance; although nature, in the latter case, is preparing for a recuperative effort (§ 675). And so the result will be influenced by the application of the remedy during the first paroxysm, or by its delay till a later, and this often in proportion to the delay. It is true, diseases generally yield most readily in their forming stage; but in intermittent fever the disease may be said to be renewed, in a measure, at each paroxysm. Like other affections, however, it acquires more or less obstinacy from the force of habit, and from the influence of local inflammations and venous congestions which so often spring up in its progress. But that habit is more or less broken during the intermission; when Nature is aiming at restoration (§ 557, &c.).—NOTE K p. 1119.

988, *a*. Here, also, may be shown absolutely the error of all the mechanical hypotheses which have been put forth as to the philosophy of bloodletting, and which have so extensively governed the application, or, rather, have led to the neglect, of the remedy. If we consider the prevailing one, that loss of blood operates by mechanically reducing the volume of the circulating mass, and thus empties the enlarged capillaries in inflammation and in the hot stage of fever, it is at once contradicted by the immediate and salutary effect of the loss in the cold stage of fever, when the same capillaries and the same instruments of disease are already so contracted that the blood has receded from them toward the central part of the circulation; while the immediate effect of the loss of blood is to determine an increased volume upon the capillaries (§ 910, 935).

988, *b*. It is, however, unnecessary to pursue the inquiry; but it is well to advert to the fact that the phenomenon now before us is equally demonstrative of the error of imputing syncope to the reduction of blood within the cavities of the heart; since, in the cold stage of fever, blood is always accumulated about that organ, and as the contraction of the capillaries is farther increased by loss of blood, so, also, is the central determination (§ 935).

For the full understanding of the foregoing subject, the inquiring reader will refer more extensively to what has been said of the agency of the nervous power in determining the effects of loss of blood.

989. The foregoing considerations enable us to understand why bloodletting is more useful just as the subsidence of the hot stage begins than at its earlier periods. Nature is now consummating her efforts at relief. The capillary vessels are every where about to contract to their natural volume, as a consequence of another modification of their vital state, and differing, therefore, from that of the cold stage, and from that which is induced by loss of blood. The secretions are about to break forth in virtue of this recuperative process, and bloodletting will now accelerate what nature is instituting. At any other stage of reaction this curative effect is less, since nature does not then so co-operate with the remedy as when the hot stage is on its decline. Should syncope, even, be induced during the rise of the hot stage, reaction will be very apt to return, though it pursue a mitigated course. A much smaller loss of blood will also subdue the general circulation when the hot stage is beginning to decline than during its rise, and leave a more permanent impression upon disease. Nevertheless, the

violence of reaction, &c., may be such as to increase or give rise to local inflammations; and where this is apprehended, or for the relief of pain, general bloodletting should be practiced early (§ 675, 863 *d*, 1003). This section involves diversified agencies of the nervous power.

Of Bloodletting in Apoplexy.

990, *a*. The modus operandi of bloodletting, as well as the adaptation of this remedy to the special circumstances of disease, and its critical influences according to those circumstances, especially in its relative effects through the instrumentality of the nervous power, may be now advantageously considered by contrasting its results in certain states of apoplectic affections with what has been said of the counteracting nature of inflammation, and of the nervous influence, in preceding sections. This influence must apply equally to all the cases.

990, *b*. It is the well-directed application of bloodletting which constitutes the principal means in the treatment of sanguineous apoplexy; and although it may be often important to delay the abstraction of blood, it will be generally necessary in the progress of the cure. Such, indeed, is the concurring opinion of almost all writers of eminence; although it is a remarkable fact that the practice is not founded upon successful experience, or any agreement in pathological views. Even those who condemn bloodletting in pneumonia, enteritis, or other grave inflammations, are neither intimidated by age, nor by expiring nature, when apoplexy makes its invasion. Some are prompted by a supposed rupture of a vessel, which they expect to stanch by bleeding from another; while a few, more philosophical, regard the effusion as the result of a morbid process analogous to secretion. It is with all, however, a mechanical operation. There is too much blood in the brain, and it must be drawn off by the lancet. That is their *modus operandi*, and that the extent of it. Hence the disastrous results of indiscriminate bloodletting in apoplexy. But, if the philosophy which I have set forth as to the operation of loss of blood be founded in nature, it will readily appear that the sudden and violent lesions of the brain in apoplectic affections offer us cases for great and unusual discrimination as to the time, extent, &c., of the remedy; while, also, they confirm that philosophy, and enforce the importance of an enlightened understanding of the principles through which bloodletting operates. It is said by Clutterbuck, that "there is perhaps no disease the treatment of which requires to be so much directed by theory or general principles as apoplexy. The practice in general use is, for the most part, unnecessarily violent; and, in some respects, contradictory. Bloodletting to an unreasonable extent, vomiting, purging, blistering, sinapisms, and a great variety of other stimulants, have all been administered with an almost indiscriminate and unsparing hand; as if, to insure recovery it were only necessary to have recourse to sufficiently active means, without much regard to their nature or effects."

990, *c*. Besides the importance of a proper reference to the influences of bloodletting in cases of apoplexy, there are often present certain inscrutable conditions of the brain which are liable to embarrass the most enlightened judgment. It is often impossible, for example, to understand the exact pathological condition of the brain, upon which the due regulation of bloodletting may essentially de-

pend. If there be hemiplegia, it is almost certain that extravasation of blood has taken place. This condition, with the rare exception of the rupture of a diseased artery, is indicative of venous congestion of the brain, with which inflammation may coexist (§ 803, 805). We have, therefore, in these numerous instances, a formidable condition of cerebral disease, and a laceration of the cerebral substance. Again, however, there may be only a state of venous congestion, or of serous effusion, or some pathological condition which is not denoted by any visible signs after death. With the exception of paralysis, the phenomena may be exactly the same in all these conditions of the disease at its invasion. In the first two varieties, bloodletting, sooner or later, is probably necessary, in almost every case, to overcome the morbid action; though its early application may induce, or hasten, a fatal result. In the last two, which are known as *serous* and *nervous* apoplexy, the loss of blood is comparatively unimportant, and may be injurious at every stage of the disease (§ 673).

990, *d*. But the treatment of apoplexy has been less the fault of hypotheses than an unsuitable application of bloodletting; neglecting the peculiar relations which the brain sustains to other organs, and the consequent modification of their properties and functions when the brain is suddenly and violently disturbed. So far as this organ is independently concerned, whether the proximate cause of apoplexy consist in pressure from excreted blood, or simple inflammation, or venous congestion, bloodletting is clearly indicated, and, to avert an impending attack, should be applied without much reserve. But when the paroxysm ensues, it is not alone the brain which suffers in a new and peculiar manner. Every vital organ sustains a shock, and each becomes a subject for particular care. Disease is now coextensive with the system, for the powers and functions are universally deranged (§ 226, 227, no. 1, 230, 231, 480–485, 489–492, 508–511, 943, 946,) and plainly deranged by nervous influences.

990, *e*. Hence the importance of ascertaining, as nearly as may be, how extensively the powers of life are disturbed in each individual case, that we may not complete their extinction by precipitate treatment (§ 920, 934, 937, 940, 941, 943, 944, 947–949).

990, *f*. The consequences, which are determined by the sudden lesion of the brain in apoplexy, will not only depend much upon the natural constitution of the individual, often upon the precise nature and seat of the lesion, and the antecedent condition of the organ, but they will be variously modified by the pre-existing state of other parts; whether the system was in a state of health at the time of the seizure, or whether important organs may have been previously diseased, and thus incur a more profound lesion after the attack, and send back upon the brain the shock they have sustained, and again receive the reverberation; and whether, also, such disease may not have developed the cerebral derangement, and remain a powerful aggravating cause (§ 514, *h*, &c.).

990, *g*. The variety of lesion sustained by the properties of life, in apoplexy, is denoted by the symptoms, and the symptoms only. The pulse of an athletic subject may become, as in cases of concussion, almost insensible at the moment of the attack; while that of the feeble may acquire a volume and force exceeding its natural state. The general circulation is roused at one time, and prostrated at another.

The nervous power has now the effect of an excitant upon the system, and again it is a deadly sedative (§ 226, 476, &c.). In one patient, the pulse falls suddenly to forty strokes in a minute, while in another it is as suddenly raised to more than a hundred. In one, it beats with staid regularity; in another, it intermits; in another, it hobbles; and in a fourth, it rises and falls in volume in coincidence with the prolonged acts of respiration. There is nothing uniform about it.

990, *h*. It need not be said how profoundly the stomach is affected, how variously respiration, how differently the voluntary muscles, the sphincters, &c., suffer (§ 476, &c.), all referable to the nervous power.

990, *i*. Considering, therefore, the varied influences of the brain upon the properties of life in apoplectic affections, and the manner in which we have seen that bloodletting affects this organ, and the consequent impressions which are propagated from it over the whole system it must be obvious, where the general lesion is very profound, that the abstraction of blood at the onset of the attack may so increase the pernicious influence of the brain upon the sinking powers of the system that neither nature nor art can repair the injury. This will be especially true of such cases if we bleed to syncope (§ 940, 941). But the abstraction of blood is powerfully felt, in a direct manner, by the vital properties of every organ; and where these powers are excessively depressed by the nervous influence, and that influence constantly maintained by the peculiar condition of the brain, it will happen, in the foregoing cases, that there will be no ultimate recoil from the depressing effect inflicted by the loss of blood. Here will be also another shock added to the direct injury from loss of blood, since the violence thus inflicted upon the system at large will be extended, by sympathy, to the brain; while this organ will reflect every pernicious impression it receives from others (§ 1056).—See p. 298, § 476½ *h*.

990, *k*. It should be also considered that effusion probably exists within the brain, and that bloodletting cannot reach this part of the exciting cause; that the effect of the effusion, although it be diminished, must continue for an indefinite time, and that if we lessen too much the energies of the system, they will at last fail from its increasing influence. While, therefore, we strive to arrest one evil there should be an equal care not to increase another.

990, *l*. The importance of bloodletting will depend, also, upon the nature of the fluid effused; of which we may, perhaps, form some conjecture from the antecedent history of the case. In serous apoplexy, the cerebral congestion, or inflammation, is generally, from the beginning, in a low state, and is probably much subdued by the effusion. It may be, therefore, chiefly the immediate object of bloodletting to diminish the impulse of the circulation upon the brain, and, perhaps, to lessen a state of congestion in the abdominal organs that may continue to operate upon the brain. Serous apoplexy, however, is not common. Dr. Cheyne and others consider the ratio of the sanguineous to the serous as 98 to 100.

990, *m*. In the sanguineous apoplexy we have a more or less different state of things, and other objects are presented for consideration, than in the serous form. We have, then, not only to lessen the impulse of blood, and to strike at any remote predisposing congestions, but we must, as speedily as possible, reduce the congested state of the cerebral veins, and thus arrest the progress of the hemorrhage,

and re-establish the natural circulation and healthy functions of the brain.

But the moment when bloodletting may be applied with advantage, and the extent of the remedy, must be directed as much, or more, by the existing state of the general symptoms as by any pathological condition that may have led to the paroxysm (§ 150, 151, 990 *c*).

990, *n*. It behooves the physician to meet every case of apoplexy with entire self-possession, and to consider that no subject requires the exercise of greater skill, and, perhaps, of firmness. It is often now as with the surgeon when he is summoned to some embarrassing operation, and in the right performance of which the life of the subject is immediately concerned. The authority of custom, sanctioned by the most acute and renowned observers, will be likely to embarrass our judgment, paralyze our independence, and hold us spell-bound, when all may be depending on the unbiased dictates of the understanding. The difference of an hour in the application of bloodletting may be for the weal or the woe of the patient. Shall we deliberate? Professional reputation may be in peril; but the greater will be the reward to a sensitive and enlightened mind. Where art can be of any advantage there will be always time for calm investigation of doubtful cases. Such are the recuperative powers of nature they will generally struggle for a time with success; at least in cases where art can be instrumental. "It is probable," says Heberden, "that far the greatest part of paralytic and apoplectic patients would recover some degree of life and strength by the unassisted efforts of nature." It is this partial recovery which we should await, in certain cases, before resorting to the abstraction of blood. If Nature be too much struck down by the blow for an independent effort, we shall hardly contribute any useful succor by inflicting another. If, also, the powers of life be greatly prostrated, action is, of course, in a languid state. Whatever disease may exist in the brain is, for the present, controlled by the same principle. Hemorrhage is suspended; and the functions, every where, whether natural or morbid, are nearly at a stand. It is here, in the severest cases, in respect to the general condition of life, as it is in concussions of the brain; when, it is said by Mr. Abernethy, "it would appear in the first stage that very little can be done." This has now become the doctrine of surgeons.

990, *o*. When bloodletting is of doubtful expediency in apoplexy, and this is commonly only soon after the seizure in cases that admit of relief, the abstraction of blood should advance slowly, and its influence be carefully observed (§ 937). The result from a small quantity of blood may be such a relief to the brain that the pernicious influence of the organ may be so withdrawn from the system that the remedy may be soon repeated, and to a greater extent (§ 961, *d*).

990, *p*. Having brought the system, in bad forms of the disease, out of its alarming prostration, either by moderate stimulation, or cautious bloodletting, or, what is generally better, by intrusting it to its own resources, it will become important to estimate the probable extent of disease in the brain and other organs. And here I cannot but repeat the important fact that sanguineous effusions are generally the result of disease, and that they very rarely depend, even within the cranium, upon any primary rupture of blood-vessels. Dissections prove

that this condition, in almost all cases of sanguineous apoplexy, is attended by venous congestion. This view of the pathology, while it is entirely more inauspicious to the hopes of the patient than that which regards the effusion as the simple result of a ruptured vessel, requires more energetic means of treatment than the latter. Indeed, were simple rupture the source of the effusion I see not in what respect art is likely to be instrumental. It cannot be, as is commonly supposed, by diminishing the force of the circulation that we obtain much ascendency over the complaint. Indeed, in many cases, where the pulse is prostrated, relief is effected while the energy of the heart rises under the influence of the lancet. The philosophy of the effects of this remedy relates mainly to its impression upon the organic properties of the capillary vessels, directly and by reflex nervous action.

990, *q*. We may conclude, then, that with all the advantages of the most enlightened pathology, and the most appropriate treatment, the apoplectic must, generally, exist for a long time in a perilous condition. In the early stages, a formidable state of morbid action is to be overcome by energetic measures, whose timely application is more surrounded by difficulties than in any other disease. The brain, too, in the cases supposed, has sustained a fearful laceration, and a concrete effusion of blood is probably compressing and irritating the whole organ, and which can, at best, but slowly undergo absorption. In sanguineous apoplexy there is also an increased liability to repeated attacks of the congestion and consequent effusion of blood.

990, *r*. It has not been my object to speak of cases that obviously admit of immediate bloodletting. These are common, and may demand an extensive application of the remedy. But the only rule that can be assigned in regard to the quantity of blood that should be abstracted will probably be found in the foregoing considerations.

990, *s*. In estimating the effects of cerebral disease on the system, we must duly consider the various relations of the brain to other parts. Considered simply as an organ, it is liable to the same modes of disease as other organs, and to the same relative sympathies as exist among other parts. But this is a small part of the important relations of the brain. It is especially destined to preside over the great functions of the body, however they may be the result of powers that exist and act in independence of the brain; and whenever its organic functions become diseased, these specific relations to the system are affected in consequence (§ 455, 456). This complex derangement, in apoplectic affections, will produce the most varied results; and, according to the influences of the brain upon other parts, and their reaction upon the brain, will be the endless variety of phenomena.

990½, *a*. In conclusion of the foregoing subject I may finally say, that, from what has been here presented relative to the nervous power, and from the extensive researches of a more critical nature in preceding sections, it appears that the nervous power is peculiar to animals; that it is a vital stimulus, *sui generis;* that its important office is to subserve the function of sympathy, and to impress upon the organic products some very special vital conditions; that its only participation in the function of motion is that of acting upon the organic property, mobility, through its primary operation upon irritability; that it is extremely susceptible of influences from the operation of external and internal causes, mental, vital, and physical; that these in-

fluences result in preternatural developments and various modifications of the nervous power, under the influence of its own nature, but corresponding, also, with the nature of the remote causes, respectively; that it is then reflected with a special alterative effect upon remote parts, according to their existing susceptibilities, and according, also, to the nature of the causes by which it is developed or modified, whether by the will, mental emotions, or by organic or physical causes, and that the motor channels which are elected for its remote effects are, apparently, independent of the order of the distribution of nerves; that, when thus reflected, it maintains, in one case, the harmonious action of organs, or disturbs that harmony in another, or induces disease in another, or becomes a curative agent in another; according to the nature of the influences which may be exerted upon it.

990½, *b*. Now, therefore, in view of all these things, as well as of what has been hitherto said of the functions of organic life, and of the consequences which have befallen the philosophy and the practice of medicine from the prevalence of the chemical, physical, and humoral doctrines of life, disease, and therapeutics, it is evident that there is nothing of greater importance in medicine than a proper understanding of the attributes of the nervous power, and that it must be regarded merely in the light of a vital stimulus, or a vital depressant, or a vital alterative, and that it has no other participation in the actions and results of animal and organic life (§ 227, 475½, 524 *d*. no. 7, 647½).

I have, finally, reserved for this place another demonstrative proof that the nervous power is in no other than the foregoing sense the cause of a single phenomenon in organic beings, and that, therefore, all the causes which bring it into operation, or otherwise affect its pronunciations, exert their influences directly upon the power itself, and that an irresistible analogy is thus brought to concur with the many specific facts in proof of the direct operation of all other vital agents upon the properties of life which are common to plants and animals, and not upon the physical structure (§ 189). I say, then, that, since the nervous system is carried into all parts of the organization of animals, but has no existence in plants, and since both animals and plants possess organic functions in common, and since, also, the organic functions of animals are variously affected through the instrumentality of the nervous system, not only by causes operating directly upon the nervous centres and the trunks of nerves, but indirectly through the circuitous route of the sensitive and motor systems of nerves, and, *especially, farther, since there is no anatomical union whatever between the extreme fibres of the sensitive and motor nerves, nor between them and the fibres or ultimate parts of any other tissue*, it follows as a physical necessity that the organic properties and functions can be influenced through the nervous system only by a real substantive agent which is entirely different from the physical structure itself, and which is capable of extending its influences from one tissue to another between which there is no physical union, and that, therefore, all the primary essential impressions must be exerted directly upon the agent itself. Whence, also, it follows, that all the results which ensue in other tissues, as consequences of the transmission of the nervous influence from the expanded nerves to those tissues, are due to primary impressions by the nervous power upon the organic properties of such tissues, *through the medium of the complex structure*. Lastly, it neces-

sarily results from the foregoing demonstration, that the organic properties appertain just as much to a real substantive agent, and are as different from the physical structure, as the nervous power is different.

The foregoing facts and arguments relative to the disconnected state of the nervous and other tissues are equally true of all the tissues respectively, and as true, also, of the organic properties as of the nervous power in the aspect of the anatomical facts (§ 168–185, 190–192, 200, 208, 215, 217, 219, 220, 226, 228, 230, 233, 233¾, 234 *c, d, e, f*, 500, 1040, 1056). *The soul offers a conclusive analogy* (§ 175 *b*).

990½, *c*. Nevertheless, if the physical fact, even as to the *sensitive* and *motor* nerves, were not demonstrably true, it would in no respect affect the laws, since those of all *vital* functions are deduced from the phenomena (§ 466); not, as with physical optics, from the mechanism (§ 131).

The Experience and Opinions of Distinguished Physicians as to Blood-letting in Inflammatory, Congestive, and Febrile Diseases.

991, *a*. It would not be appropriate to this work to set forth the vast range of experience in favor of blood-letting in the treatment of inflammatory, congestive, and febrile diseases, which I have explored in the Medical and Physiological Commentaries, and as contributed by men whose genius, observation, and success, will command the admiration of ages. But great controverted questions call for something more than opinions, however great the authority, or however those opinions may imply all the requisite experience. *Unless excepted, I refer to the early stages of disease* (§ 557 *a*, 869).

991, *b*. Bampfield introduces his remarks by saying, very justly, that, "In medical science, all reasoning and hypothesis must yield to the results of experience, and deductions from facts. I have employed venesection," he adds, "not only in dysentery, but other internal and external inflammatory complaints in the East and West Indies, with the most happy results. And is it not our *sheet-anchor*, our principal remedy, *in the cure of yellow fever*, when had recourse to within the first eighteen hours of the attack?"

Mr. Bampfield exposes the origin and fallacy of the objections that have been made against bloodletting. He "has been astonished and shocked to find bloodletting in hot climates condemned;"—while others, of the temperate climates, think it only adapted to the tropics, or condemn it universally.—NOTES FF p. 1135, GG p. 1138.

992, *a*. Let us consider, next, the solemn statements of one who is known as the "Ulysses of Medicine," from his vast practical opportunities in numerous climates, as Surgeon-general of the British Army; and let us observe how his experience illustrates and confirms the great principles relative to bloodletting, and the universality of those principles, and their practical application under all circumstances of climate. It should be premised, however, that I have rarely found the heroic practice of Jackson necessary or expedient in its largest extent; and should be inclined to attribute more to the modifying influences of climate in the following cases, were it not that his practice was remarkably distinguished for its decision and success in various parts of the globe, while it is sustained by many of the best observers in every variety of climate. Thus, then, Robert Jackson:

"The end is not attained in many cases, particularly in the more concentrated forms of fever that appear among the military in tropi-

cal climates, at a less expense than eighty or ninety ounces of blood drawn at once." After stating, in another place, that the quantity of blood abstracted in fever, at one time, during the years 1813 and 1814, at the Hospital of the Royal Artillery, was rarely less than three pounds, frequently four or five, and sometimes six pounds, Dr. Jackson remarks that such quantities taken at once "may appear unsafe to some readers. But I am warranted to say, from a retrospect of the whole proceeding, that *no accident occurred in any instance from the most excessive bleedings* that were made; and I may add, that the strength was so little impaired by this apparently revolting practice, that the greater number of persons, who were treated in this manner, *returned to their duty within a fortnight, in the full vigor of health*" (§ 1019, *d*). Such, also, was Jackson's practice in other countries (§ 973 *b*).

992, *b*. Let us also hear Jackson upon the specific point of cerebral inflammation, which demands, as I have said, more than any other disease, a fearless and extensive use of the lancet (§ 974).

"The quantity of blood," says Jackson, "which may be abstracted in cerebral inflammation, without even compromising the safety of the patient's life, exceeds a measure which, were my experience of the fact not clearly ascertained, I should not venture to lay before the public. Four pounds, taken away at one time, may be considered a moderate bleeding in the more concentrated forms; six pounds have been taken on several occasions, and a hundred and twelve ounces at a single bleeding in some. The practice, so formidable in appearance, implied no danger. It saved life by *direct effect* (§ 938 *b*, 955, 1019 *d*). The practice is reasonable in theory (§ 924–934, 942, 944, 948, 949). It is proved in experience to be founded in truth. *The quantity, moreover, is to be measured by the effect which arises under the abstraction, not by an opinion formed under the presumption of what may be right.*"

In some cases of fever attended by cerebral inflammation Jackson sometimes abstracted a hundred and sixty ounces of blood, or ten pounds (avoirdupois), in a day; and he remarks in connection with this statement, that, "instead of danger at the time, or debility as a consequence of such extraordinary depletion, fainting did not always occur, and the patient, in *most cases*, returned to his duty within *eight days*" (§ 974, 1068 *c*).—Notes Ff p. 1135, Hh p. 1138, Ccc p. 1148.

992, *c*. In the foregoing (§ 992, *b*), as in the concentrated forms of fever (§ 992, *a*), we have a clear exemplification of what I have taught as to the tendency of inflammation to maintain the system against the depressing influence of loss of blood, and that when the brain is the seat of inflammation an exciting nervous influence is more powerfully developed, and operates with greater force upon the diseased state of the organ, and upon the heart and whole capillary system, than a similar affection of any other part (§ 480–483, 971–974).

Secondly,—"The quantity," says Jackson, "is to be *measured by the effect* which arises under the act of abstraction, not by an opinion formed under a presumption of what may be right. *Whatever be the quantity, it is the effect produced which constitutes the* RULE *for guiding the measure.*" I have thus repeated this doctrine, for it is the most important that can be found in the annals of medicine. This rule is universal, and it is for this reason that the best practitioners never sug-

gest the *quantity* of blood which should be abstracted in any given form or case of disease.

Thirdly,—"Instead of debility, as a consequence of such extraordinary depletion," says Jackson, "fainting did not always occur; and the patient, *in most cases*, returned to his (military) duty *within eight days*, in the full vigor of health" (§ 1019, *d*).

What an admirable illustration is this of the fallacy of the temporizing practice, or the more sad effects of the stimulant treatment! How forcibly it evinces the importance of making a decisive impression, at one blow, in all grave inflammations! How truly does all this proclaim the existence of peculiar properties of life, in whose alteration the essence of disease consists, and whose restoration is effected by the direct impression upon them of loss of blood! How forcibly does it refute the humoral pathology, and that not less erroneous assumption that disease is constituted by some positive change of structure, or the yet more glaring fallacy that it consists in debility!

992, *d*. I have said that it has not often fallen to my lot to carry out Jackson's practice, excepting in principle (§ 992, *a*). This may be owing, in part, at least, to the fact of having commonly enjoyed the opportunity of applying remedies at the early stages of disease. Where I have found the full extent necessary, it has been mostly among children; estimating the ratio of the loss according to the relative ages and size. The most remarkable example has occurred in the case of my only child; whose general history of health is stated in the Commentaries for another purpose (vol. i., p. 693).

Not long after his very protracted disease had given way, and being at the age of nine years, he was suddenly and violently attacked with well-marked inflammation of the brain, lungs, and small intestine. I raised him to an erect posture, and bled him till syncope came on. The symptoms gave way; but, in six hours afterward, those of the brain, and, in an inferior degree, of the lungs and intestine, had reappeared. I then bled him again, in the same posture, and to the extent of syncope. Before exhibiting any medicine, I still awaited the ultimate effect of the loss of blood. The cerebral symptoms gradually presented themselves again, and I bled him, for the third time, as before, at the expiration of about twelve hours after the second bloodletting. Soon afterward, I gave him one tea-spoonful of castor oil, which completed the direct course of treatment. In two days after the last bloodletting, I took him upon the rail-road a distance of five miles, and returned (§ 955 *b*, 958 *a*). It may be worth adding, in connection with my former statements relative to his extreme infirmity of health during the first seven years of his life, that he has enjoyed a very robust constitution since the illness described in this section; being now seventeen years of age (§ 870 *aa*, 892$\frac{4}{5}$ *i*, 974, 1068).

The quantity of blood abstracted in the foregoing case was very large at each abstraction, and exceeded, in the ratio of the age and size of the subject, what I shall have recorded of the experience of others.

993. The experience of Moseley corresponds with that of Jackson, and where the remedy had been apparently of ample extent, he remarks that, "it has frequently happened in the fever of the West Indies, that accidental bleeding from the orifice when the patient had

fallen asleep, to far greater quantities than has ever been directed to be taken away, has carried off the fever entirely, and the surprise on discovering a profusion of blood in the bed has been changed to joy for the alteration produced in the patient" (§ 973, *b*).

There are few practitioners of much experience who have not witnessed similar events (§ 1019, *e*).

994, *a*. And how well is all this sustained by Dr. Rush, who has "always observed that the cure of a malignant fever is most complete, and the convalescence most rapid, when the bleeding has been continued until a paleness is induced in the face, and until the patient is able to sit up without being fainty." "Bleeding," he adds, "should be repeated while the symptoms, which first indicated it, continue, should it be until four fifths of the blood contained in the body are taken away;"—being conformable to the precept of Celsus, that

"*We must not run from one remedy to another, so long as that remains which was there at first*" (§ 1007);—or, as Porter has it, "*it is not sufficient to diminish an increased action, unless the constitution be kept, until the period of danger is over, in a condition that will render a renewal of that action unlikely to occur*" (§ 954, *b*).

994, *b*. The same result of an almost unsurpassed experience is again and again reiterated by Rush. "The half-way practice of moderate bleeding," he says, "has kept up the mortality of pestilential fevers in all ages and in all countries. It is much better not to bleed at all than to draw blood disproportioned in quantity to the violence of the fever (§ 960, *b*). Bleeding must not be discontinued so long as the symptoms which first denoted its necessity continue."

In very prostrating forms of fever, he says, that "bloodletting lessened the sensible debility of the system. Hence patients frequently rose from their bed, and walked across the room, a *few hours after the operation*" (§ 569 *e*, 898, 992).—NOTE FF p. 1135.

995. And so, also, Armstrong: "In pneumonia," he says, "bleed your patient to approaching syncope; otherwise, instead of benefiting him, you will *do him harm*" (§ 960, *b*).

And again: "In inflammations of the serous membranes, or of the parenchymata, I bleed," he says, "more decidedly than I ever did." "I have treated nearly three hundred cases of severe *enteritis* with bleeding, &c., and with a success far greater than I have heard from any other plan. There is no success on record at all comparable with it" (§ 1005, *e*, *i*).

996. And so Mr. Lawrence, who says, that,

"In cases of inflammation, where the blood comes freely out of the vein, I generally let it run on till it stops; for that seems to me the only way of doing good" (§ 960).

997, *a* Wardrop, in his excellent work on Bloodletting, lays down the same rule and the same experience. Thus:

"When a large quantity of blood is not taken away at the first bleeding, in inflammation, or at a second depletion quickly succeeding, I have generally found that, on all future occasions, it is seldom practicable to abstract any considerable quantity, however necessary it may appear; and thus it is, that when copious bleedings are not employed at the commencement of the treatment of inflammatory diseases, and if the patient afterward recover, it has generally been from the employment of a great number of bleedings. Moreover, it is *only*

in such cases wherein the *pernicious effects* of bleeding are exemplified" (§ 950). "There seems always," he says, "to be a disposition in patients, as well as in medical men, to economize blood" (§ 960, 1007 *b*).

997, *b*. It is an aphorism with Gregory, that, in severe inflammations and fevers, "the danger of a large bleeding is less than the danger of the disease."

998. "With gangrene, infarction, and abscesses in prospect," says Beddoes, "transient syncope, from loss of blood, is a slight evil. The *rule, that the constitution recovers much more kindly from debility by bloodletting than by disease*, affords great encouragement" (§ 569, 1007 *b*). "Numerous facts show that in high inflammations the lancet can scarce be used too freely."

999, *a*. Jackson says that "Dr. Rush carried subtraction of blood to a great extent in yellow fever; but the quantity subtracted was obtained by repeated subtractions, not by abstraction at one time. The mode of depletion was not abrupt, such as arrests disease by force, and such as I have in view in the present history" (§ 929–934, 938 *b*, 942, 944, 948, 949, 955).

999, *b*. It may be true that Dr. Rush sometimes fell short of the proper effect. It may be true that his moral courage was unequal to that of his great cotemporary, since each was extensively denounced as "a murderer;" and Rush could hardly fail of being sometimes embarrassed by his strange delusion that "debility is the universal predisposing cause of disease." Nevertheless, a glance at a preceding section (§ 994) will assure us that the general charge is without foundation. His philosophical acumen led him to bleed extensively, and with success, in many cases where there appeared no hope to others but in powerful stimulation. There is also a distinction to be made between the yellow fever of Philadelphia, and that which called forth the heroic practice of Dr. Jackson. The prostration of the heart from intense sympathetic influences reflected from the vessels engaged in the morbid processes was often greater, and there was less active inflammation to sustain decisive bloodletting, and more of venous congestion to diminish the tolerance of loss of blood, and to impart malignancy to fever, in the former, than in the latter instance. Nature, therefore, frequently interposed an obstacle which compelled the American philosopher to be sometimes content with small and repeated abstractions of blood (§ 974, 975, 977, 983, 985).—NOTE FF p. 1135.

999, *c*. The foregoing reference to Rush's doctrine of "debility" (§ 999, *b*) leads me to an extension of a preceding section, where I have explained the acceptation in which I employ the term *prostration* (§ 961, *b*), and which goes with former sections in elucidating the nature of that condition which is commonly mistaken for "debility" (§ 487 *h*, 569). What I now purpose saying is, that the condition of the heart takes a very large share in those morbid demonstrations which have led to so many theoretical and practical errors. But, the heart, in these cases, is mostly obedient to disturbing influences propagated upon it by the instruments which are carrying on the morbid processes, and where the powers may exist in a very exalted, though, also, otherwise modified, state. Those extreme vessels, however, determine upon the heart a prostrating nervous influence, and often, also, an accumulation of blood about its right cavities, which contributes yet farther to the embarrassment of the organ. This will be readily ap-

preciated from what has been variously said upon relative topics in former sections; but the whole principle may be seen by referring to the instrumentality of the nervous power in the operation of loss of blood; while, also, the philosophy which is there set forth borrows a corresponding illustration from the subject embraced in this section (§ 916–922, 929–938, 942–949, 500 *m*, 687½–689, 694¾).

The heart, being prostrated in the foregoing manner, increases, by reflex nervous actions, the morbid state of the instruments of disease, complicates all the phenomena, and does its large part in leading all but those who will take the trouble to investigate the philosophy of life, and analyze the symptoms of disease, and apply them critically, according to the share which belongs to each tissue and organ, to rest their intellectual efforts upon *the symptoms* alone, and their hopes in tonics and stimulants. But, he who will penetrate this seeming labyrinth, yet accessible to all, will discover, at once, that the remedies should be addressed to the immediate instruments of disease, and that whatever will bring relief to these will certainly relieve the heart, and dissipate the phantom, debility; while, on the other hand, every cause that may increase that pathological state of the instruments which are the absolute seat of difficulty and danger, will as surely engender, sooner or later, increasing embarrassment of the heart, and a consequent multiplication of the morbific influences which radiate from the centre of the circulation (§ 892 *c*, 965 *b*, 966–968, 500 *m*).—Nole I.

1000. Few medical philosophers have done so much for therapeutics as Sydenham; and with his name is associated one of those great revolutions in practice in which bloodletting is the foremost remedy. There was then, as now, that timid caution which has contributed so largely to the common prejudice against the abstraction of blood.

"Nothing," he says, "is more frequently urged as a capital argument by those who condemn bleeding, than the mischief which arises from bleeding in an improper manner" (§ 892 *a*, 892¼ *c*, 960 *a*, 1005).

1001, *a*. The "improper manner" to which Sydenham refers (§ 1000) is justly, however forcibly, expressed by Botallus. Thus:

"Bleeding does no service in many cases, either because persons have recourse to it too late, or use it too sparingly, or commit some error in both these particulars. But, if our fears be so great, and we take away so small a quantity of blood, how is it possible to judge what good or mischief bleeding may do? For, if a disease which requires the loss of four pounds of blood for its cure, and yet but one be taken away, destroy the patient, it does not therefore prove destructive because bleeding was used, but because it was employed in an improper manner (§ 950, 965 *b*). But ill-designing and indolent men endeavor to lay the fault to the bloodletting; not because it did really do mischief (otherwise than by its improper use), but because they desire to give every body an ill opinion of it. Or, suppose they do not do it from wickedness, they cannot be excused from ignorance and perverseness." It is also his opinion that "one hundred thousand men perish from the want of bloodletting, or from its not being timely employed, where one perishes from excessive bloodletting, *when practiced by a physician*" (§ 1005).—*Note* p. 729.

1001, *b*. Botallus was critically right in qualifying his remark by adding, "when practiced by a physician." No little of the prejudice which rational medicine encounters arises from the former indis-

creet use of the lancet, in the hands of the surgeon, immediately after concussions from falls, &c. The sad experience of some of the most able has led to admonitions like that which is recorded in a former section (§ 960 *a*, page 720; § 1007, *b*).

But shall *physicians* deliberate when inflammation is careering in the great organs of life? Can there be a question of the applicability of bloodletting to phrenitis, pleuritis, peritonitis, pneumonia, and to many other grave inflammations, under their ordinary circumstances? It is true, we have lately seen practitioners, Dr. Dickson, for example, boasting of their success without having "ever wetted a lancet." But I do not believe that this exclusive practice has many open advocates; and to admit its imputed results would be to renounce the dictates of our own and of common observation. A more limited opposition, however, to bloodletting in grave inflammations is making an inroad upon former experience; nor is it the least remarkable circumstance that it enlists the most able disciples of the anatomical school. And although they may often admit the utility of the remedy in a general sense, when they come to its practical application to particular diseases, we are told that it is either useless, or prejudicial (§ 960). [The "stimulating plan" is now in vogue, 1860.—*Note*, p. 872].

1002, *a*. But once more, as to the prostrating forms of fever, from which it will farther appear that neither the yellow fever, nor others of an analogous character, have been so modified by climate, seasons, &c., as to preclude the abstraction of blood; and that if loss of blood be demanded by simple inflammation, it is much more so when inflammations are complicated with idiopathic fever, and especially when that fever is of a "malignant nature," and constantly imparting its malign influence to the local developments (§ 999, *b*).

Dr. Stevens, of the West Indies, the celebrated advocate of the saline treatment of fevers, affirms, in his late work on the Blood, that, "Those who were well bled, in the yellow fever, and properly evacuated in the beginning, almost invariably recovered." "He took blood till he had nothing to fear from increased action." I have introduced this statement for the purpose, also, of showing that the credit which he imputes to the saline treatment of yellow fever is wholly due to the decisive bleeding and purging which he adopted. The saline practice in fevers was pretty largely in vogue some centuries ago, and has been lately brought forward to give plausibility to the humoral doctrines.

1002, *b*. Mr. Evans recently states, that in the Indies "we bleed largely in the yellow fever, repeating the operation in two hours if there remain the slightest pain on pressing the epigastrium; and, in general, if any gastric affection remain after the second bleeding, toward the close of twenty-four hours, we repeat it a third time, and apply the leeches afterward."

This practice, as I learned on a visit at different islands a few years ago, prevails throughout the West Indies; and, in Eastern India, it is well known that bloodletting was never in higher repute in all congestive fevers than at the present day.

1002, *c*. Baker remarks, that it is necessary to abstract, by repeated bleedings, twelve or more pounds of blood in the malignant fevers of Brazil. The distinguished Hillary urges free bloodletting on the first and second days of yellow fever, and in the worst forms of the disease

1002, *d.* "Here is a case," says Mills, "of the typhus gravior of Cullen, or such as is commonly denominated putrid. The petechiæ (so much dreaded by the opponents of bloodletting) disappeared after the second bleeding; an effect I *daily* witness from the use of the lancet, which clearly proves that this symptom proceeds from vascular action."* And so, also, Dr. Parry; who introduced the only successful or philosophical treatment, that of bloodletting, in purpura hemorrhagica; now treated by stimulants and astringents, but in vain.

1002, *e.* By the same process of induction from the vital phenomena that conducted Parry to the true pathology of purpura hemorrhagica, Lind, Blane, Milman, Rouppe, Fordyce, Girtanner, Pinel, Baglivi, Heberden, De Haen, Moore, Bampfield, Darwin, Beddoes, Woodall, and others, inferred the inflammatory nature of scurvy (the great pillar of humoralism), and practiced bloodletting as the first step in its treatment. *Diet* here illustrates the *vis medicatrix* (§ 853).

1002, *f.* What shall be said of the celebrated jail fevers, where every body now stimulates? Let us hear the illustrious Pringle, who, more than any one of the old school, taught the pathology of living putridity. He was one of the last of a long line at whose beginning stands the Roman projector of humoralism; having died in 1782, when solidism again triumphed for awhile. He was a man of vast experience, great success, and of universal renown. He was an English baronet, professor, physician-general of the British forces, and studied and treated diseases in Germany, Flanders, Scotland, London, &c. He was, in brief, like Robert Jackson, a "Ulysses in Medicine," and, like Jackson, he found that the same diseases required the same general treatment in all climates; being utterly regardless of the humoral doctrines at the bed-side of disease.

Pringle, I say, bled in all forms of fever—jail fever, typhus syncopalis, and whatever the imaginary degree of putridity. "Bleeding," he says, "in *putrid* fevers, is indispensable." "It is the first thing to be done in the beginning of the treatment."

Riverius, an eminent French physician of the seventeenth century, like Pringle, considers "*putridity* a reason for bleeding at all stages of petechial fevers,"—"*non ullum unde eminere periculum*,"—*nor did any injury result from it.*

Grant says that, "even in the *putrid diathesis* of fevers (as he calls it), where much evacuation is required, more or less blood ought to be taken before proceeding to other evacuations."

Baillou, in the enlightened days of humoralism, advises "bloodletting in all *putrid* and malignant fevers, even when there is a tendency to hemorrhage from *dissolution* of the blood" (§ 1002, *c*). And so of many other distinguished theorists in the school of putridity.

1003. Let us now regard the language of the best experience as to the treatment of a form of fevers for which "bark" is commonly supposed to be an almost unfailing specific, but which, even its alkaloids, often entails the most obstinate forms of local chronic disease, when untimely, or excessively, employed (§ 892, &c.). Thus:

"It may be laid down," says Armstrong, "as an established principle, that if venesection does not absolutely cure intermittent fevers, it paves the way for other remedies, and is, on that account, highly necessary." Or, as Hippocrates has it, "*he who would purge bodies, must first make them permeable.*" Baglivi, Torti, and other distin-

* See NOTE T p. 1125.

guished Italian physicians, affirm, positively, that the local complications of their intermittents could not be cured without bloodletting. Sir John Pringle, in treating the intermittents, mild or malignant, in "low, marshy countries, found it necessary to begin with opening a vein, and to repeat the operation according to the urgency of the symptoms." "A person," he says, "unacquainted with the nature of this disease, and attending chiefly to the paroxysms and remissions, would be apt to omit this evacuation, and to give bark prematurely." This is what led Cleghorn into his fatal mistake (§ 1005, *h*). But we ultimately hear from him, that, "for his part, when called early enough, he used to take away some blood from all people, of all ages, when affected with tertians, unless there was a strong contra-indication." And so Senac: "the physicians bleeding five or six times in an epidemic tertian." Cragie says, that, in Great Britain, remittents require the loss of twenty-five to thirty ounces of blood (§ 960, *a*).

1004, *a*. It would be superfluous to extend the foregoing species of testimony afforded by modern practitioners in favor of bloodletting in the treatment of inflammatory, congestive, and febrile diseases. In the article on Bloodletting, embraced in the Medical and Physiological Commentaries, I have presented the experience of all the distinguished practitioners from the earliest ages of philosophical medicine, and it may be there seen that without exception they have concurred in their testimony as to the transcendent utility of blood-letting.

1004, *b*. The "father," himself, says, that, "in all active inflammations we should open a vein, and if the disease be vehement and pros trating, the loss of blood will bring strength to them that lose it,—'*robur ipsis affuerit.*'" He abstracted blood for the relief of those syncopes which attend the worst forms of congestive typhus; as did, also, Galen, Celsus, Aretæus, Trallian, Paul, Aurelian, Avicenna, &c.

1004, *c*. Oribasius, about three hundred years after Christ, states that he was bled to the extent of two pounds for an attack of the plague, and that his reliance was mainly upon this remedy. Galen bled largely in this disease, and he is the first who records the quantity. "I remember," he says, "to have taken away in some instances, at one bleeding, six pounds of blood, which immediately extinguished the fever, *nor was there any loss of strength in consequence*" (§ 992). Such was his success by this mode of treatment, that the spectators exclaimed, *εσφαξας, ανθρωπε, τον πυρετον*;—"Oh! man, thou hast cut the throat of the distemper."* Avicenna says that he has sometimes abstracted, in the plague and "putrid fevers," at one bleeding, five or six pounds of blood,—"*quinque aut sex sanguinis libræ auferantur*" (§ 1019, *d*.) Bleeding largely in the plague was a general practice after the revival of learning, and was practiced through the 16th, 17th, and 18th centuries; as it was, also, in other fevers, and in inflammatory and congestive affections. The exigencies of the disease was the criterion as to the quantity of blood to be abstracted. Septalius states that it was the universal custom of physicians to bleed in the plague of 1575 and 1576. "*Communi consensu in hujusmodi nobile remedium nullo modo pretermittendum esse decreverant.*" And so Riverius, of a similar epidemic, "*Deo sit laus et honos! quotquot hoc tractati sunt modo feliciter evaserunt!*" In later times, Faulkner commends bloodletting in the plague, and says that "when the blood was in a dissolved state, the remedy was not less

* Galen's success so raised the hostility of the Roman physicians as to banish him from Rome for several years; they denouncing the remedy, and he immortalizing them.

favorable." Assalini remarks that, "At the commencement of the plague, I saw the necessity of making use of bleeding in proportion to the strength of the patients."—NOTE FF p. 1135.

And, as to the less prostrating forms of fever and inflammation, Baglivi supplies an example of the general practice in the 16th, 17th and 18th centuries. He observes, "Omnes acutas et inflammatorias febres, hic Romæ, curare incipio per sanguinis missionem." And so of all the eminent Roman physicians down to the recent day of Rasori.

1004, *d.* It has been often thought remarkable that Hippocrates had never designated the quantity of blood which may be demanded by any given form of disease. The reason is, he was too much of a philosopher. He knew that no rule, in this respect, would be useful; but, on the contrary, unwarranted by nature, and liable to the worst results. Look at his writings, and you will find him bleeding according to the symptoms, and the general history of the case. This, in deed, he often says, was his *rule*. He had no other in relation to quantity.

1005, *a.* Before leaving these practical considerations it may be well to listen to the confessions of a disastrous experience which befell some of the most enlightened of our profession from their neglect or misapplication of bloodletting. Let us select examples of prostrating forms of disease, where it too commonly happens that its nature and exigencies are misapprehended, or imperfectly understood, and where "debility" is regarded as the essential pathology, and is supposed to demand the stimulant plan of treatment. These examples will cover the whole ground, and disarm the stoutest prejudice in other less terrific forms of prostrated strength.

1005, *b.* The distinguished Mr. Hey shall speak first, and of those cases of puerperal fever in which "debility" presents its most appalling aspects. This able man had unhappily treated the disease either with tonics and stimulants, or with inadequate bloodletting. He finally introduces a case (his ninth case), which was the last in which Mr. Hey employed the bark and wine, or procrastinating, treatment. It was the last mistaken act that divided the professional life of Mr. Hey into two distinct eras. The patient died, and with her death came his full conviction of his error. "If the disease," he says, "is clearly ascertained, no other consideration is of much importance. The state of the pulse affords little information, either as to the propriety of bleeding, or the quantity of blood to be taken away; and if we are deterred either by the apparent weakness of the patient, by the feebleness and frequency of the pulse, or by any other symptom, from bleeding *copiously, we shall generally fail to cure the patient*."

1005, *c.* And now mark another maxim of this able man, who felt his way to truth over many a victim of malpractice; and what he says of puerperal fever is equally applicable to all other fevers when complicated with inflammation or venous congestion. "There is a vast difference," he says, "in the puerperal fever at different times, and in different situations and circumstances. In some cases it appears like a phlegmonous inflammation; in others it destroys with more rapidity and certainty than the plague. But, the means of cure are precisely the same in both; but in the worst forms the measure of bloodletting *is greater and less limited*, and the period within which it must be employed is far more circumscribed." "The truth is," he says

(still lamenting his mistakes), "that bloodletting has seldom been fairly tried. Either the quantity of blood taken away has been too small, or the time when it was taken too late for any use; and thus the principal remedy for the disease has been brought into disrepute" (§ 965 *b*, 1000, 1001.—Also, § 500 *m*, 694¾, showing the import of the pulse).

1005, *d*. But Mr. Hey was mistaken as to the novelty of the practice. Like many others, he depended too much upon his own genius and experience; neglecting the past, and thinking that medicine is the work of a day. Hence his ignorance of the labors and of the choice experience of his predecessors. Bloodletting had predominated, as the only great remedial agent for all inflammatory affections and fevers of the most depressing character, ages before Mr. Hey came to illustrate the truth by other martyrs; and this in England, Germany, Arabia, Italy,—the island of Cos (§ 1004, *b*). The "disrepute" of which Mr. Hey speaks was then only local, not general; for, while the temporary reign of the "bark and wine treatment" crippled the best practitioners in Great Britain, reason and sound practice were unrestrained in other countries.—NOTE FF p. 1135.

1005, *e*. The equally able and distinguished Mr. Gordon had the same melancholy experience with bark and wine, and the procrasti nating treatment of puerperal fever; and, like Mr. Hey, he shifted his practice to early and copious abstractions of blood, and has left a record of the happy fruits of his dear-bought knowledge. He has one remark which proves the inutility or the positive injury of inadequate bloodletting. "He lost," he says, "EVERY patient when he bled only to the extent of ten or twelve ounces; but that ALL recovered when he had the *courage* to abstract twenty or thirty ounces" (§ 950, 965 *b*). Armstrong, by "copious bloodletting, lost only five out of forty-three cases" (For the works &c. quoted see *Med.* and *Phys. Comm. ut cit.*).

1005, *f*. And here is Denman, the eminent author of works on Midwifery, who, like Hey, and Gordon, had carried havoc into the chambers of puerperal women. He, too, once bowed at the fascinating "idol, Debility;" but having lost most of his patients under the seductions of this *ignis fatuus*, he turned himself to the Genius of philosophy, and, as a noble atonement to mankind, left behind him, like Gordon, and Hey, a record of his errors.

"I am now convinced," he says, "by *manifold experience*, that my reasoning was fallacious, and my facts groundless, and that which I had considered proofs of the insufficiency, or the impropriety, of bloodletting in puerperal fever, ought, in reality, to have been attributed to the *neglect* of performing it in an efficient manner, and at the very beginning of the disease" (§ 1000, 1001).—NOTE H p. 1117.

1005, *g*. Leake says that, "every puerperal woman, in Lowder's time, who was blooded, died; ten ounces being considered a large bleeding;" while Leuret, accustomed to the timid practice of Lowder, affirms that, "he had never seen a woman escape after bleeding." Here it will be readily perceived that the inefficient bloodletting aggravated the disease (§ 950, 965), just as it is allowed to have done, in the same affection, by Hey, and Gordon, and Denman.

1005, *h*. With the familiar name of Cleghorn are associated, as in the former instances, a sound judgment and large experience. Let us consider his experience in a pestilential, prostrating, bilious pneumonia that ravaged the island of Minorca; and let us not fail of being

admonished by his example, also, of the importance of taking for our guide the lofty principles of our science, and the experience which is taught by adversity as well as by happier auspices.

This epidemic pneumonia was complicated with idiopathic, congestive, fever, attended by "insidious intervals and treacherous remissions," and by great prostration, or "debility" (§ 569). And now mark the vacillating treatment so characteristic of weaker minds, or where ignorance of medical philosophy leads to an obstinate adherence to the suggestions of prejudice and timidity. Mark, also, the uselessness, or the injury, of small abstractions of blood, and the triumph of greater (§ 950, 965, 1000, 1001).

"I attempted," says Cleghorn, "to cure the patients by bleeding once or twice a day, except during the *insidious* remissions; but they *generally perished.* This unforeseen event startled me greatly, and led me to review the whole progress of the disease," &c. He then determined "to adopt the advice of Duretus, and to use the lancet with more caution." But his failures became still more frequent and mortifying (§ 811–815)—NOTE FF p. 1135, CCC p. 1148.

"At length I was convinced," he says, "that instead of too much, too little blood had been taken away in the beginning, and that I had been *misled by the insidious intervals.* I then began to bleed more plentifully, taking away thirty or forty ounces within the first three days of the distemper. This method succeeded well in several of the cases" (§ 965, *b*).

Still he was not satisfied. "At last," he goes on, "about the middle of March, when the disease raged with the utmost fury, having found that there was the most absolute necessity for bleeding largely without delay, *in order to preserve life,* I began to put in practice the following method of cure, WHICH SELDOM OR NEVER FAILED; not only in young, robust people, but even in those of more *advanced age,* provided I saw the sick before *the end of the third day.*"

This "method" consisted in abstracting blood in the horizontal posture, "till the pains abated or the patient began to faint; taking from eighteen to twenty-seven ounces, avoirdupois. If the symptoms continued, *a few hours afterward* the same quantity was again taken away, without regarding the state of the blood, &c. Next morning, if there were *any remaining symptoms,* the bleeding was repeated, and the blood carefully weighed. From fifty-four to sixty ounces were frequently taken away during the first twenty-four hours of attendance. *If any symptoms returned,* the patients were *immediately* bled again to the amount of fourteen or twenty-seven ounces."

What a contrast in treatment,—what a contrast in results! Bloodletting, decisive bloodletting, was at last almost the only remedy employed, and it now succeeded in every instance where its timid application had been, before, as universally fatal (§ 950, 954 *b*, 965 *b*, 1000 1001). But a "horizontal posture" is unfavorable and may not be safe.

And here let us not fail to observe the same results in the practice of Cleghorn as in that of Jackson and others in analogous epidemics (§ 992–999). "Under this method of treatment, it was remarkable," says Cleghorn, "to observe how rapidly the sick recovered their usual health and strength, notwithstanding the great loss of blood which they had sustained; while many, who had been bled more sparingly, continued in a languid, infirm state, for *some months.*" Patients of the lat-

ter class were only imperfectly relieved. Congestion still remained about some of the great viscera, especially the liver, by which, also, the powers of digestion were maintained in a prostrated state. Under these circumstances, errors in diet, and mental and bodily fatigue, often contribute to maintain and exasperate the consecutive derangements; till, at last, it frequently happens that a slow increase of the local diseases becomes the exciting cause of another explosion of the constitutional malady. Thus the patient not unfrequently goes on revolving, year after year, through mitigated and exasperated conditions of disease, which more decisive treatment by bloodletting, at its onset, would have prevented (§ 868, 883 *b*, 892 *d*).

I have stated the several successive steps of Cleghorn's plan, that each may be compared with the others. The quick transition from wrong to right evinces the hand of a master. The record is full of the most important instruction; and while I hold it up to the present generation, I would that not only its practical instruction, like the sad experience of Gordon, and Hey, and Denman, should be duly regarded, but equally, too, that the frankness of each should be emulated.

1005, *i*. Dr. Boyd, also, subsequently to Cleghorn's time, in describing the malignant fever of Minorca, states that bloodletting must be carried to the extent of positive relief, without reference to quantity. He sometimes repeated the operation four times in a day. Our inland practitioners, at the south and west of New York, will see in the congestive fever of Minorca a simile of their own as sometimes complicated with "bilious pneumonia;" while their practice responds more or less to that of Boyd and Cleghorn.

1005, *j*. Erysipelas is another wide-spread and prostrating disease in its epidemic form, which has beguiled the multitude into the fatal use of "the bark and wine treatment." In his Essay on Bloodletting, Dr. Wardrop states that, "during a long attendance at a public hospital, a certain physician had never known bloodletting employed in erysipelas, and that nearly all the cases that he had seen of that disease, affecting the head and face, had terminated fatally." And so Armstrong: "The wine and bark system is of all the most fatal practice in erysipelas." "Five individuals had erysipelas in one house, were treated with bark and wine, and all died" (§ 995).

When "erysipelas" presents itself as an epidemic, it displays its connection with a far graver form of disease in the abdominal viscera; especially hepatic congestion. And such, probably, is always its complications when sporadic only. But, *the symptom* is conspicuous; and hence the name, and hence, also, the usual treatment. The attention is apt to be turned, mainly, to the sympathetic inflammation of the skin. The obscurely marked, or what Cleghorn would call the "insidious," affection of the liver, &c., is not appreciated, and the force of the treatment, therefore, too often takes the wrong direction. Nothing, indeed, is more common in "epidemic erysipelas" than an absence of the cutaneous affection in the worst forms of the disease; and these very cases, from their exact resemblance in all other respects to those which are marked by *the symptom*, go by the same name, and get the same treatment. I have seen many instances of this nature; particularly during the late prevalence of the disease in Vermont and New-hampshire. I have seen their subjects fall victims to the disease within two and three days from the attack, where there was no inflammation

of the skin; and, in other instances, where the skin was mottled with patches of a low degree of inflammation. I found the practitioners, however, generally taking the right course, and regarding the affection of the skin as symptomatic only. But, the disease presented itself in a very grave form; and it was interesting to observe that, while it had many victims under opposite modes of treatment, the greater success of the depletive plan generally won over the few who had preferred stimulating (§ 689 *l*, 861, 894, *mottoes*, 905½ *b*, 961 *b*, 964 *c*. Also, *Med. and Physiolog. Comm.*, vol. ii., p. 603–607, *Article* ERYSIPELAS).

1005, *k*. Let us consider, also, the adverse results of the stimulant, and even of the tartar emetic treatment of pneumonia (§ 892⅘, *g*). It is the opinion, for example, of Dr. Stokes, that "*General bloodletting is not to be considered the chief means of removing the disease.*" "In the typhoid form, the *best practice is to use wine* in conjunction with local bleedings." "General bloodletting," he says, "is to be used *with extreme caution*, and the vital forces are to be carefully supported." But, "*In two instances only has he seen pneumonia cut short by bleeding*"! This admission appears to be conclusive against the doctrine of "saving the vital fluid," according to this distinguished writer, and especially that of "supporting the vital forces by wine" (§ 569 *e*, 983).—STOKES, *on Diseases of the Chest*, p. 226, 227, 231.

Dr. Williams, in his work on Diseases of the Chest, appears to have enjoyed as little success in the treatment of pneumonia, and for the obvious reason that he considers "local depletion the utmost that can be attempted in typhoid pneumonia. Considerable advantage may, under these circumstances, be sometimes obtained from *dry cupping* on the chest, which, for a time," he thinks, "tends more effectually than even bloodletting, *to draw* the fluids from the congested organs, while it does not *waste the blood* from the system" (§ 960). This philosophy has numerous admirers, who regard it, with Dr. Arnott, as "a great modern improvement in the healing art," and as one of the luminous proofs that the nineteenth century has witnessed a great revolution in medicine; or, as Louis has it, that "medicine is now in its infancy." Apropos, of this distinguished Frenchman, who is opposed, mathematically, to the abstraction of blood in pneumonia, erysipelas, "typhoid fever," and acute intestinal inflammation; with their complications, also, of other local inflammations. And so, too, of many other distinguished French physicians, who rely mainly on the watching system, or on the tartar emetic practice. But, what are the results? Chomel makes the average mortality from pneumonia, at the hospitals, one in four; Louis lost one in three; and Legarde one in three. Leconteulx reported twelve out of thirty, by the antimonial treatment. These last were treated by Laennec.

But, in these United States, where bloodletting is thoroughly practiced, the loss does not exceed one in twenty to twenty-five. There is here, however, no exclusive system, no "numerical method;" but the treatment proceeds upon Hippocratic principles. The symptoms, and various other circumstances, attending each individual case, regulate the practice. It is not all bloodletting, nor all tartarized antimony. Cathartics, calomel, blisters, &c., form as well a part of the treatment. Nor have we much knowledge of the effects of bloodletting in the advanced stages of the disease: mainly for the reason that we adopt it early (p. 517, *note*).*—NOTES F p. 1114, MM p. 1141.

* Our large cities and hospitals, but not the country, must be now excepted (p. 872, P.S.).—1860.—Bloodletting is now every where greatly abandoned.—1867.

It is said by Dr. Osborne, in his work on Dropsical Diseases, that "Since what has been termed the tartar emetic treatment has been introduced into Great Britain, and the practice of bleeding has consequently been to some degree discouraged, it appears to me that the advanced stages and fatal terminations of pneumonia have been frequent; and in this judgment I am confirmed by records on the large scale" (§ 960, *a*).—*See* P.S. 1860, at p. 872.—NOTE F p. 1114.

1005, *l*. As to any modifying influences from climate in England, either in respect to pneumonia, or other inflammations, or all the varieties of fever, we have only to consult such authors as Armstrong, Jackson, Johnson, Wardrop, Elliotson, Lawrence, Smith, Davies, Weatherhead, &c., &c., to be convinced that those diseases are now, as ever, the same there as in America, and require the same general plan of treatment. Looking back to the age of Sydenham, and along the intermediate periods, we find that every thing, on this subject, has remained without any essential change. It is practice alone that has fluctuated. And, if we cast our recollections through the vista of time, over various countries, till we reach the age of Hippocrates, we shall still find that diseases, of a given denomination, have been the same, and have ever required the same general treatment.

1005½, *a*. From what has been now said, under the present division of my subject, and more especially from the wide range of experience presented in the *Medical and Physiological Commentaries*, it appears that there is one universal consent among the great physiological practitioners as to the importance of decisive bloodletting in all forms of active inflammation, and in high grades of fever; whether it appear in the shape of the plague, of yellow fever, of typhus, or other inflammatory or congestive forms. It has been so from the earliest days of the science; in all countries, in all climates, in all constitutions, at all ages; and, whether in the Mediterranean or the Caribbean Isles, the jungles of Asia, the pestiferous regions of Africa, the paludes of Italy, or the high, and temperate, and salubrious countries of Europe and America, we witness the immutable principle that diseases and their general method of cure are every where nearly the same. Constitution, habits, and age, certainly modify the details of treatment, more or less; climate comparatively little. The great fundamental laws of disease remain without change, as do, also, the leading conditions of disease. We have all that Hippocrates described before our own eyes, and we are astonished at the identity. We think him, at one moment, a prophet; and when, at the next, we realize a simple narrative of only what he observed, we are either amazed at his sagacity and philosophy, or that we should have been so slow to have discovered the truth ourselves (§ 624, 1068, NOTE GGG p. 1151).*

1005½, *b*. The human constitution, its laws, susceptibilities, &c., are, in a general sense, every where the same; while the remote causes of disease are the same now as at the beginning of time, produce their effects upon the same properties, whose nature cannot be permanently affected (§ 180–182, 286), and whose results are connected by a chain of analogies. The pathology of inflammation, or of simple or congestive fever, therefore, is the same, respectively, in principle, at all times, and in all countries, and the great principles of treatment must also be immutable. But, modifying causes impart various shades of difference to every epidemic, to every individual case. To under-

* See NOTES FF p. 1135, GG 1138 HH 1138.

stand the complex, or even leading condition of each case, what its general nature, what peculiarities may arise from various causes, what the exact adaptation of remedies, how much the successive changes may be due to nature or to art, requires unceasing vigilance (§ 624).

1006, *a*. And now let me ask, whether the vast experience, and the precepts relative to bloodletting, of the able physicians who have given to medicine its rank and dignity, are to be impugned by chemists, or by the prejudice, or the limited, or the careless, observation of many physicians, who are too apt to deceive themselves into the belief that they imbody the only experience which can be available in disease, or which enlightened philosophy can approve (§ 1007, *b*)?

Doubtless, it will appear absurd that I should have embraced the *chemists*, and as foremost, too, in the preceding interrogatory. But, is it not the order of the day (§ 5½ *a*, 349 *d*, 960 *a*, page 719)? And being so, I will reply, once more, in the language of Dr. Paris, when he was defending medicine against the harmless recreations of the Chemists, about the year 1825, and mainly because Professor BRANDE had ventured upon the open opinion that chemistry was neglected in medical education, and that the "*London Pharmacopœia is a record of the want of chemical knowledge where it is most imperiously required.*" The answer, perhaps, is abundantly set forth in a former section (§ 676, *b*). As showing yet farther, however, the instability of science, and as embracing a precept which every lover of truth will do well to ingraft upon his morning prayer, I shall quote Dr. Paris once more, though upon a subject simple in its nature, and of very minor importance to that which is relative to the laws of organic life and the great principles of medical science. Thus:

"I cannot conclude these observations upon Mr. BRANDE'S attack, without expressing a deep feeling of regret, that a gentleman, whose deserved rank in society, and whose talents and acquirements must entitle him to our respect, should have condescended to countenance and encourage *that vile and wretched taste* of depreciating the value and importance of our most venerable institutions, *and of bringing into contempt those acknowledged authorities which must always meet with the approbation of the best, and the sanction and support of the wisest, portion of mankind* (§ 676, *b*). And I shall here protest against the prevailing fashion of examining and deciding upon the pretensions of every medicinal compound to our confidence, by a mere chemical investigation of its composition, and of rejecting, as fallacious, every medical testimony which may appear contradictory to the results of the Laboratory. There is no subject in science to which the maxim of Cicero *more strictly applies*, than to the present case. *Let the Ultra Chemist, therefore, cherish it in his remembrance, and profit by its application:*

"'PRÆSTAT NATURÆ VOCE DOCERI, QUAM INGENIO SUO SAPERE.'"—PARIS' *Pharmacologia*, p. 103. *London*, 1825, (§ 1034).

And now, for the purpose of showing how any special commentary upon any given substitution for the well-settled method of induction or for any well-ascertained laws of Nature, is alike applicable to any other fundamental innovation, and how, also, the overthrow of one grand scheme of the day is the immediate parent of another, I shall quote from the *Medical and Physiological Commentaries* a paragraph relative to M. Louis' attempt to foist upon medicine the celebrated

"NUMERICAL METHOD," and ask the reader to apply it to "*Organic Chemistry in its Applications to Physiology;*" and to "*Animal Chemistry applied to Pathology and Therapeutics.*" Thus:

"Thus mounted upon the wreck of philosophy, 'the Numerical Method' ('*Organic Chemistry*') became the engine in rearing that fabric whose construction it was destined to serve. This is the charm with which the Numerical Method (Organic Chemistry) is invested; while it gives to its author that ascendency in mind which few can truly obtain by the legitimate rules of induction. 'After much deliberation,' as Isocrates says, 'he found the thing could not be compassed in any other manner;' or, as our Author has it, 'fortunately for the progress of science, the Numerical Method (Organic Chemistry) is considered by the most judicious and experienced men as *a necessary instrument for establishing general principles in medicine*' (§ 5½ *a*, 349 *d*, 960 *a*, page 719). Accordingly, former systems, and former facts, *fell as* BY ENCHANTMENT (§ 376½, 433). The mind sickened at the absence of all principles to guide it, and was therefore the more willing victim when assailed by the irresistible power of numbers (*symbols*) (§ 960 *a*, p. 719). If the demonstration was made with reiterated professions of *a regard for facts*, it was because the method could have had no existence without them; while the perpetual epithet of '*rigorous*' left no room for skepticism. But, as related, according to Lord Bacon, 'of good Queen Bess, the Commissioners used her like strawberry-wives, that laid two or three great strawberries at the mouth of their pot, and all the rest were little ones. So they made her two or three good prizes of the first particulars, but fell straightways.'"—(*Med. and Phys. Comm.*, vol. ii., p. 782.)

"This manner of digression, however, some dislike as frivolous and impertinent; yet we are of Beroaldus' opinion,—such digressions do mightily delight and refresh the reader. They are like sauce to *a bad stomach;* and we do therefore most willingly use them."

1006, *b*. The reader will recollect that I had been last speaking of the respect which is due to the experience of the great sages in medical philosophy. I was early led to listen to their conclusions, and to adopt their counsel, as summarily expressed in the foregoing maxim derived from Cicero (§ 1006, *a*). For thirty years I have watched attentively the effects of bloodletting as practiced by myself and by many others, and have long since come to the conclusion, that it is safer to put "the two-edged sword" into the hands of the ignorant, or the imbecile, or those who make a trade of the profession, than to forever blunt its edges, so that it will not cut, before it be trusted to their use. We every where see victim after victim sacrificed to timid admonitions, and worse example; while you, and all of us know, that it is a rare phenomenon that a patient is slain, seldom injured, by the lancet. This is the test, and the strength of it is before the reader.*

1006, *c*. On the other hand, is it not too often the case that eminent and able teachers, who constantly instruct us to pause where bloodletting is indicated, observe a phlegmatic silence as to the injurious tendencies of active internal agents, or urge them upon us as if they were as powerless as water? These, not bloodletting, make up the great abuses of practice. Here, protestations against abuse would come with a benign effect; or if uttered, they are apt to be in an unworthy spirit of distrust of the whole medical art.—NOTE F p. 1114.

* In 1870, *after a practice of fifty-four years, large and without intermission, I reiterate the same. Vide* § 1068, *b*, p. 870.

Let us at least consider that all other remedial agents of any great importance, even those of the best antiphlogistic nature, are irritants under many circumstances of inflammation, and are, therefore, more or less liable to increase that affection, unless morbid irritability be previously subdued by loss of blood. This is even true of antimonials and ipecacuanha, in irritable states of the alimentary canal. How obvious, then, the importance of often preparing the way for their salutary effects by loss of blood; and, in doing which, we also greatly supersede the necessity of other remedies.

1006, *d*. If we contrast even the scanty cases of injury from uterine hemorrhage, and other accidental losses of blood that may be sustained in health (or try our best at the records of excessive bloodletting, as preserved by the most watchful Brunonian), with the terrible and wide-spread effects of procrastination, or timidity, in the use of the remedy where it has been demanded by disease, and, more than all, with the "bark and wine treatment," we shall have little to fear from the possible abuses of the lancet. A few may be rash from ignorance,—perhaps from the encouragement of others; but will not this encouragement stimulate a host to lay aside their fears, and to moderate their Brunonian practice? Where, then, according to the "numerical method," will be the balance (§ 569, *e*)?—NOTES F H.

1006, *e*. Where inflammatory diseases are comparatively mild, their mildness will naturally restrain every practitioner; and when existing in severity, there will be little or nothing to fear from the liberal abstraction of blood so long as the symptoms resist this principal remedy, and its proper auxiliaries. At most, there can be only now and then a disastrous result; while timid caution has its myriads of victims. Defective judgment there must always be; and it is better, therefore, that it should lean to the side of safety. If going wrong, the error, in respect to *excess* of bloodletting, will be very soon discovered. The timidity of man needs no encouragement, when the question relates to "debility," and "the precious fluid" (§ 569, *e*). But come to cathartics and emetics, nay, tobacco, opium, aconite, belladonna (§ 960, *a*), he is bold and indiscriminate. Here is opened, I again say, an inexhaustible field of inquiry,—far more abstruse and difficult than the management of bloodletting. You may bleed in intestinal inflammation, perhaps to a vast extent, and speedily surmount the disease; when, had an irritating cathartic been exhibited, the scale might have been as speedily turned in the other direction (§ 878, 893 *n*, 1063 *c*, 1064, 1065).

1006, *f*. Different ages of the world appear to have been distinguished by different degrees of moral firmness, and by remarkable differences in practical habits; and the light of settled experience and of the best philosophy in medicine is almost as apt to suffer a paroxysm of darkness at the advanced as at the earlier stages of science. Certain it is that knowledge had reached a high advance at the time of Hunter, when bloodletting had given a temporary place to the stimulating plan of treatment. Theory and experience governed in one case, hypothesis in the other. No sooner, however, had Mr. Hunter announced the substitution of the stimulant for the depletive treatment, than we hear from Robert Jackson, that "Abstraction of blood in contagious fever, which, but a few years since was viewed with abhorrence, even branded with the epithet of murder, is *now* considered the main engine of successful treatment" (§ 960, *a*, p. 717).

And, if we look abroad upon the characteristics of the present day, do we not find in animal magnetism, homœopathy, the humoral pathology, the supplications to the laboratory of the chemist for revelations as to the laws and processes of living beings, in health and disease, and many kindred errors and superstitions, a melancholy commentary on the human mind?

1006, *g*. The general treatment of inflammatory and febrile diseases having been well ascertained by Hippocrates and his immediate successors, all departures from their philosophy must be of short duration. It will remain forever a model in the science of medicine, as much as Grecian architecture, and Grecian poetry, will continue to be the true models of taste through all coming time. The reason is, that the philosophy of medicine, like the principles of taste, has its foundation in nature, and that, of all her institutions, medicine is the most intensely interesting. The master-spirits of antiquity observed nature correctly, and drew their conclusions from this only source of correct knowledge. They formed no deductions from the distortions of nature, erected no hypotheses upon the ruins of organization, nor sought in the laboratory of the chemist what can be found only in living beings. Drawing their conclusions from Nature herself, they must remain impregnable against all the adversities of time. The fabrics of philosophy may be mutilated; but the breach will be soon repaired, and the offender will find his proper place in the archives of history. Where the foundation has been substantially laid, the innovations of error are like the momentary peltings of the storm upon the "house that is built upon a rock" (§ 376½, 376¾).—NOTE FF p. 1135.

1007, *a*. The general experience of which I have hitherto spoken has been mostly relative to bloodletting in the active conditions of inflammatory and febrile affections. But its advantages are very far from being limited to diseases of a concentrated form, and of rapid progress. They reach, also, and profoundly, the moderated conditions which make up the varieties of chronic inflammation. And here, again, I cannot but entertain the hope that I may have so demonstrated the close similitude of those forms of inflammation which are contradistinguished by the designations of *active* and *passive*, that they will cease, at least, to be regarded as extremes of disease that require exactly opposite modes of treatment; and, therefore, that a better practice may obtain in those chronic cases which have been generally consigned to "bark and wine, and an invigorating diet" (§ 752–756. Also, *Med. and Phys. Comm.*, vol. ii., p. 524–546).

1007, *b*. A few examples will best illustrate and enforce the principle; and to render them emphatic and comprehensive, let us select constitutions broken down by prolonged suffering and wretchedness. An instructive case is recorded by the eminent Kentish. It was the squalid subject of a mortified extremity, which had been advancing to its present state for a year. At this period the leg was removed above the knee. The patient had been crowded for months with tonics and stimulants, and "was reduced to bones." The stump put on an inflammatory action. The admirable surgeon saw nothing but death in prospect, unless he opposed the dictates of philosophy to the prejudices of the lookers-on. "What!" said they, "bleed a poor man who has been confined above a year, and is quite reduced to a skeleton! Oh, shame! shame!" But philosophy triumphed, and ig-

norance stood rebuked. Blood was drawn, and nature began to rally. Still, the system remained oppressed with the effects of former disease, and of former practice. More blood was again and again taken; and at each outlet nature acquired fresh vigor. The inflammation gave way, and the patient recovered. Near a year afterward Kentish saw his patient, who was then, at sixty years of age, a monument of the benefits of science, and of moral courage (§ 863 *h*, 998, 1001). In such cases the hypothesis of *anæmia* displays its worst.

Dr. Borland, a hospital surgeon at St. Domingo in 1796 and 1797, cast away the tonic and stimulant plan which had prevailed, and employed bloodletting and cathartics in the treatment of ulcers. By these means "he often succeeded," says Jackson, "even in persons who were emaciated to the last degrees of emaciation by the continuance of the disease" (§ 992, *a*, 1057 *k*).

1007, *c*. Here is another case of a parallel nature; only more illustrative of the safety and utility of bloodletting in enfeebled states of the constitution, where disease may demand the remedy in more robust subjects. It is a case of *diabetes*, by Dr. Barlow, in the "Cyclopædia of Practical Medicine." The subject, *a boy*, was reduced by the disease to a feeble and emaciated state. In this condition he was bled to the extent of 209 ounces, or thirteen pounds, within fifty-one days. The operation was repeated twelve times; so that each bleeding of this emaciated boy averaged seventeen ounces. The result of it was, a rapid restoration of health and strength, and a return to his plough (§ 992 *b*, 1032, *d*).—Note Z p. 1130.

1007, *d*. Again: "A lady," says Dr. Wardrop, "in a state of pregnancy, had been greatly debilitated," &c. "She was emaciated, and so feeble, that her recovery was, by those around her, considered hopeless. She had a distinct tenderness, on pressure, in the epigastrium, and her pulse, which at first gave the impression of great languor, on more minute examination, was very contracted, feeling like a thread, and incompressible, while the heart's action was vigorous. Bloodletting was immediately resorted to, though with hesitation, by the medical attendants. No sooner had a few ounces of blood flowed from the vein, than the pulse began to rise and acquired volume, and upward of twenty ounces were abstracted before its vigor was subdued." Recovery then went on progressively (§ 997).

1008. The foregoing cases of chronic inflammation (§ 1007), which are common in the walks of the profession, concur in showing that medicine is a science of principles, and that a general treatment is universally applicable to inflammation at all stages of its existence, and under all circumstances. Bloodletting may not always be an appropriate remedy; but a low, or non-stimulant diet, may be the principal antiphlogistic means (§ 752–756, 960, 975 *c*, 1006 *b*).

Of Bloodletting in Infancy and Old Age.

I shall now devote a brief consideration to the applicability of bloodletting to the diseases of infancy and of old age; especially with a view of presenting the experience of a few able practitioners.

1st. *Of Bloodletting in Infancy.*

1009, *a*. We have already seen how the operation of remedial agents, as well as the pathology of disease, is more or less modified

by the physiological peculiarities that are incident to the well-marked stages of life (§ 153–159, 574, &c.).

1009, *b*. These peculiarities are strongly pronounced in infancy; and, when speaking of that period of life, it was seen that diseases are marked by great activity, and by a rapid progress (§ 576). Hence it is obvious that there should be a corresponding promptitude of treatment, and with remedies that make their impression speedily and profoundly. But, it was also said, that nature is now strongly inclined to the restorative process, and that there is great susceptibility to the action of remedial agents. For these reasons, therefore, the same remedies operate with greater effect than at adult age; so that in many cases where general bloodletting would be indispensable at the latter age, leeching may be equally efficient in infancy; or an emetic, or a cathartic, perhaps, may effect what loss of blood could alone achieve in later life (§ 1008).

1009, *c*. But, where bloodletting is demanded by the diseases of infancy there is no age at which it is better borne, and none at which its early application is so important. It may be also said, in a general sense, that either general or local bleeding is indispensable in all the grave internal inflammations of infantile life; and that the general method should always be practiced in the cerebral inflammations and cerebral congestions of this age, as of all others (§ 974). In similar affections of other organs, leeching is generally preferable in *early* infancy, as indicated under the philosophy of the operation of loss of blood (§ 927 *b*, 925).

1010, *a*. The annals of medicine abound with the best experience in favor of bloodletting in the inflammatory affections of infants.

Sydenham remarks, that, "bloodletting may be as safely performed in young children as in adults, and in some of their diseases there is no curing them without it."

1010, *b*. Rush was an unhesitating advocate of bloodletting in in flammatory diseases at all stages of infancy. "It is more necessary," he says, "in the diseases of infants, than in adults" (§ 1017, *c*).

1010, *c*. Piorry carries bloodletting in the cerebral inflammations and congestions of infants to a great extent,—entirely beyond any thing which I have witnessed; quite as far as quinia in his treatment of indurated spleen (§ 892, *k*). He employs from one to several venesections, and twenty to fifty leeches to the head, with purgatives, &c. This is, doubtless, excessive; but such is the fatality of infantile phrenitis, and such the ability to bear the loss of blood in cerebral inflammation, that the remedy should have no limit short of affording relief (§ 974, 992 *b*). Again, it is the experience of this distinguished observer of the effects of loss of blood, that, "in many young children affected with trachitis, large evacuations of blood have enfeebled them but little;" though "excessive hemorrhage has sometimes produced convulsions." Such has been my own observation, and also of excessive umbilical hemorrhage. I have seen no resulting death.

1010, *d*. Evanson and Maunsell think, "that in the child, more particularly, bleeding is required in the first stage of all acute inflammations. It may be practiced with safety in the youngest infant, provided we hold in view the relation between the necessities of the case and the strength of the patient." "The buffing of the blood," say they, "is not a safe guide in the child; as we have diseases absoluto-

ly requiring bleeding (*e. g.*, croup, bronchitis, &c.), which seldom produce the appearance in question."

1011. It is unnecessary to multiply examples of the foregoing experience. They abound in the archives of medicine. Even at an early era of the art bloodletting was practiced as fearlessly in infancy as it was at adult age.

1012. As to my own habits, they have been always uniformly one way. Where inflammation has affected any important organ, or has been otherwise attended with danger, and it seemed not likely to yield at once to milder means, I have taken no risk, but have resorted, without delay, to the *remedium principale;* nor have I ever had occasion to regret a practice which I would so earnestly commend to others (§ 576, *e.* Also, P.S. 1860, at p. 872, and NOTE F p. 1114).

1013. Finally, it cannot be doubted that Lommius is right in the opinion, that,

"It is much more eligible to snatch a child, by means of bloodletting, from imminent danger of death, however the strength may be wasted, than to let him perish by the violence of the fever."

2d. *Of Bloodletting in Old Age.*

1014. Here, again, as every where else, we find that physiology lends its powerful aid in the treatment of disease, and agrees with the most enlightened experience. Old age is but a summary expression of all the natural obstacles which have accumulated in the way of the organic functions, and which are about to arrest them forever (§ 580-584, 633). The properties of life are now most incapable of sustaining any of the lesions by which they are invaded at earlier ages. They are approaching their natural extinction, and are readily abolished by disease. They are crippled by physical causes of their own production, and have lost much of their susceptibility to the ordinary effects of remedial agents. Changes from a morbid to a healthy condition are slowly determined,—save only by that remedy which makes its powerful, instantaneous, and simultaneous impression upon the main instruments of vital action throughout the body. In every part the properties of life sustain a deep and abiding effect from loss of blood. Their condition is directly and instantly altered in the instruments of disease, and this alteration is maintained by corresponding reflex nervous influences determined by other parts (§ 514, *h*), as well as by the continued operation of a diminished volume of blood, and an equalized circulation. The secretions break forth ere we bind up the arm; and thus nature comes to our aid by another efficient process (§ 862, 863). It is all the work of a moment; and the great revolution begun in every part, it may, and often does, terminate speedily in health.

In the formidable diseases of old age, therefore, the remedies must be such as shall reach profoundly the properties and actions of life, and reach them without delay. Such as would be insufficient in youth must surely fail when declining nature is least disposed to co-operate with art.

1015, *a.* The foregoing conclusions are amply corroborated by a large and enlightened experience, which equally demonstrates the groundless nature of the prevailing objections to bloodletting in all the diseases of old age; save only those apoplectic affections in which the

system may be least able to sustain the shock of the operation (§ 990).

In the *Mém. de l'Acad. Roy. de Méd.*, 1840, is a report by M. Prus, setting forth the safety and advantages of bloodletting as practiced extensively in the inflammatory affections of the aged occupants of the two immense establishments, the *Hospice de la Vieillesse*, and *Bicêtre*. He also adds, that, in consequence of the changes which the arteries undergo in aged people, we should always examine the state of the pulse at the heart. "How often," he says, "have patients, whose radial pulse was feeble and irregular, but whose heart announced an energetic action, been bled with the highest advantage, and thus preserved from a speedy and otherwise inevitable death!"

1015, *b*. Such, too, is the experience of Hourman and Déchambre in their treatment of the inflammatory diseases of the old women of *La Salpêtrière;* and M. Piorry bears his testimony, that aged men bore the same abundant bleeding (*des saignées abondantes*) as the old women of Salpêtrière.

1016. Such, then, is enlightened hospital experience, and only a small proportion of such experience. It is manifest, therefore, that if bloodletting be thus admissible and important with the aged inmates of public infirmaries, there is no ground for that distinction which has been set up, in a general sense, between hospital and private patients, and which enjoins the use of tonics and stimulants in one case where it admits of bloodletting in the other (§ 752–756).

1017, *a*. But, since "experientia docet," it may be useful to some to be informed circumstantially of what has happened, in the way of experience, in the private walks of the profession.

Hippocrates, Galen, Celsus, Trallian, and other ancients, advocated bloodletting in the inflammatory diseases of old age. "In bleeding," says Celsus, "the physician should not consider so much the age as the strength of the patient."

1017, *b*. We are told by Wepfer that it is a very prevailing custom among the Swiss, even at eighty and ninety years of age, to resort to bloodletting once a year, or oftener, as a prophylactic.

"I admonish you," says Vitel, "against the advice of those physicians who would dissuade you from bleeding the aged, who may be the subjects of inflammatory or eruptive fevers. The fear of debility is unfounded. Bloodletting is as necessary to them as to the young, and not less beneficial."

F. Hoffmann remarks, "Communis, sed *pessimus error* est, ætatem senilem plane non ferre sanguinis subtractiones, quasi vero in grandævis non redundaret sanguineus latex, ut potius ejus et virium defectu laborarent." "In senili ætate magis necessaria sanguinis missio, quam alia ad morbos grandævis familiares arcendos," etc. "Venæsectio sepius senibus utilissima, imo ad longævam vitam confert." "Complura certe memoria teneo exempla senum, qui ad nonagesimum annum fere, salvi, incolumes et a morbis ætate provectis familiaribus immunes vixerunt, *solo venæsectionis remedio, bis per annum admisso.*" "Id quod etiam a me in *peculiari dissertatione, De Magno Venæ sectionis ad vitam sanam et longam Remedio,* assertum est ac demonstrandum."—*Opera*, t. i., p. 135, 455, 456.

Forestus bled the aged equally without hesitation,—"firmus puer, et robustus senex, tuto curantur."

Van Swieten, the able practitioner and learned commentator, considers bloodletting as important at the extremes of age, as at the intermediate periods.

Finally, all the best writers of the sixteenth and seventeenth centuries advocate bloodletting for the inflammatory and febrile diseases, not only of middle age, but at the extremes of life. They protest, also, against arresting spontaneous hemorrhages, even when occurring at advanced age. The Brunonians have looked on with admiration, when nature has thus rescued the sick from the evils of the bark and wine treatment (§ 890, *e*).—Notes Ff p. 1135, Gg p. 1138, Ii p. 1139.

1017, *c*. In later times, the records of medicine continue to abound with demonstrations of the safety and necessity of bloodletting in the inflammations and fevers that may befall old age.

From what was stated of Rush's experience of bloodletting in infancy (§ 1010, *b*), it appears that he considered the remedy most important at the extremes of life; for, in another work, he says, "Experience proves that bloodletting is more necessary, under equal circumstances, in old age, than in any other."—(See my *Examination of Reviews, in Med. and Phys. Comm.*, vol. iii., p. 76–78.)

Hosack deprecates the prejudice which exists against bloodletting in old age.

Sir G. Blane demonstrates the safety and utility of the remedy in the inflammatory diseases of aged people. He states the case of an individual at the age of one hundred years, who was cured of pneumonia by free bloodletting from the arm. In another instance, a lady of eighty-two years suddenly lost, by spontaneous hemorrhage from the nose, a quart of blood, "which was followed neither by faintness nor weakness, but by improvement in health, in point of vigor and alacrity."

Frank cured an octogenarian of pneumonia by bleeding him nine times. Gui Patin cured his father of pneumonia, at the age of eighty, by bleeding him freely from the arm eight times. Frèteau bled at the age of seventy to the extent of four pounds in six days.

And thus might I go on with numerous other coincident authorities; all showing individually, and proving collectively, that old age, *per se*, constitutes no objection to loss of blood. But, were there even hazard in the remedy, its possible dangers would be incomparably less than those of many acute diseases which now so readily destroy. It is no defense that the patient dies *naturally*, when the chances of life are withheld by the neglect of bloodletting.

Spontaneous Hemorrhage.

1018. I shall now briefly consider nature in her efforts to relieve the system of inflammations and congestions; since it is from the various expedients of Nature that we derive many of our best indications of cure; and the summary mode in which she institutes the hemorrhagic process, and the consequent relief of protracted diseases, are alone conclusive against the Brunonian doctrine of debility, and may encourage the timid practitioner in the use of the lancet (§ 862, 863, 890 *e*, 990 *m*).

1019, *a*. John Hunter has seen several quarts of blood thrown up from the stomach in a few hours, even by emaciated patients; and recovery has speedily followed the evacuation. Cases of this nature

are witnessed by all practitioners of much experience. The same immense quantities of blood are often discharged from the lungs, and intestine; breaking up the most formidable congestive fevers, and chronic inflammations which have resisted all other means of treatment for years (§ 733 *d*, 890 *e*).

1019, *b*. Lancisi relates the case of a man of seventy years of age, who suddenly lost, in a threatened attack of apoplexy, eleven pounds of blood from his nose, and four more in fifteen days afterward, without any sensible failure of strength.

1019, *c*. Boerhaave "has known almost the entire blood of the body to have been lost by hemorrhage, and yet the subject recover."

1019, *d*. Haller relates many examples of excessive hemorrhage. In one of his cases, one hundred and twenty-five ounces of blood were lost at each menstruation, for several years; besides a daily abstraction of blood from the arm for fourteen months. In another instance, he states that one thousand pounds, or four barrels of blood, were lost in one year, or nearly three pounds daily for that period. In another there was a hemorrhoidal flux of five pounds daily for sixty-two consecutive days, or a total of three hundred and ten pounds; being probably twice the weight of the whole body. One more lost one hundred and ninety-two ounces, or about thirteen pounds, from his stomach, in a single night, and recovered. Haller, himself, lost one hundred and twenty-eight ounces, or eight pounds of blood, within twenty-four hours.—(See special *references* in *Med. & Phys. Comm.* vol. i.)

1019, *e*. Similar examples are constantly presented to our observation, and a large variety may be found assembled in the Medical and Physiological Commentaries. They show us that when Nature takes the work in hand she does not stop to calculate the ounces, or the pounds, but pushes on till she has accomplished a rational purpose. "Honest Brunonians," says Dr. Beddoes, "have, of late, minutely recorded cases, to them incomprehensible, where immense discharges of blood have suddenly stopped *protracted* fever, and left the patients improved in strength" (§ 890, *e*, 993).—NOTES FF p. 1135, GG, II.

1019, *f*. Among the multitude of these extraordinary hemorrhagic effusions it is rare that death is an immediate consequence (§ 890, *e*), and rarer still where art has superintended the loss of blood. In the latter case, syncope comes, in good time, to the aid of the patient; far sooner than in the spontaneous process. Nor can art imitate nature in the full extent of her depletory system. The philosophy which respects the difference in effects appears to be this. When the remedy is instituted by nature, the parts concerned in the morbid action are made the instruments of relief, and the general law of adaptation is in force (§ 137 *c*, 733 *d*, 847 *g*). The peculiar modification of action upon which capillary hemorrhage depends, and the influence it exerts upon the system at large, resist the earlier effects of loss of blood when artificially abstracted in the same way as the loss is resisted by inflammations. I have seen this principle operating with various effect in inflammations, according as they are modified by remote causes, and according to the activity and extent of disease, the organ or organs affected, &c. (§ 805, 813, 922 *b*).

1019, *g*. The more we interrogate nature as to the loss of blood the more shall we find her proclaiming that this is her expedient, beyond any other, by which she attempts the removal of fearful diseases.

Hæmoptysis, hæmatamesis, the hemorrhoidal flux, intestinal hemorrhage, are all instituted for this purpose. We constantly witness the spontaneous effort where the properties of life are so prostrate that art looks on with dread and amazement; and what nature had thus wisely begun is often declared to be the effect of a putrid disruption of the living body, and calls for every counteracting means. Fortunately, these means sometimes consist of the lancet, and other antiphlogistic remedies. But this, with many, is only where the strength is vigorous, and where it is feared that unrestrained nature may possibly reduce it. Examples of this kind are common in pulmonary hemorrhage; and, although in these instances the blood be taken with a view of astringing a suspected rupture of a blood-vessel, the error does not affect the true philosophy of the case; and when nature may be too "sparing of the vital fluid" to overcome the real condition of the lungs, a singular illustration will be obtained of a co-operation of the lancet toward a salutary result where it had been employed to defeat the curative effort of nature (§ 922 *b*, NOTE BBB p. 1148).

1019, *h*. But error is often committed in these cases. If hemorrhage be profuse, it should be allowed to go on within the limit of safety; since the depletion proceeds from the instruments of disease. A rapid abstraction of blood from the arm, superadded to the hemorrhage, may arrest the spontaneous discharge too speedily; while that which is artificially taken would be more curative if left to the natural process. But, again, where the spontaneous discharge is small, the lancet may be imperatively demanded; while it is here employed with greater caution than in the former cases.—NOTE F p. 1114.

Of misapplied and excessive Bloodletting, "Morbid Irritation," and "excessive Reaction from Loss of Blood."

1020. In the Medical and Physiological Commentaries I have investigated extensively those reputed consequences of loss of blood which are known as "morbid irritation, and excessive reaction" (vol. i., p. 239–281).

1021. We certainly meet with examples of the foregoing nature, arising from improper bloodletting. But, it is generally too little, not too great a loss of blood, which does the mischief. The untoward results are owing to the unfavorable impression which is thus made upon the organic properties, both by the direct effect of the agent, and by the operation of the nervous influence upon the heart and the main instruments of vital action (§ 965, *b*). The heart, in consequence, beats either with greater frequency or greater force. This is what is denominated "irritation" and "excessive reaction," and is assumed as a proof that too much blood has been abstracted; when, on the contrary, had the loss been carried to a greater extent these phenomena would have been rarely presented (§ 500 *m*, 687½, 694¾).

1022. And now to show conclusively that the foregoing consequences depend more or less upon imperfect bloodletting, and a consequent aggravation of disease, it will be found, as I have shown extensively in my former Essay on Bloodletting, that in most of the cases recorded by Dr. Marshall Hall and other advocates of the doctrine of "excessive reaction," that the symptoms and post-mortem appearances, as by themselves recorded, denote either the antecedent existence of inflammation and a subsequently exasperated degree, or inflammation

resulting from the loss of blood, or from an antecedent predisposition. The last two causes may act conjointly; and, as I have already shown, too small an abstraction of blood is not an unusual cause of inflammation. Excessive bloodletting, on the other hand, is a rare phenomenon; but, unlike too small a loss, it may establish inflammation independently of any antecedent predisposition (§ 950, 965 *b*).

1023, *a*. When inflammation is induced by excessive loss of blood, the physiological influences are not the same as those which obtain when it ensues upon, or is aggravated by, too small a loss (§ 965 *b*, 1022). In very numerous cases of this nature there has been a pre-existing tendency to the disease; or, more frequently, a morbid condition already established, but not fully developed. Thus, it is not an unusual event that the physician abstracts blood for pain in the head, or a "stitch in the side," or for some uneasiness of breathing. The abstraction of blood is judiciously moderate. But, there has been an accumulating tendency to inflammation; and the blood thus abstracted proves not to have been commensurate with the demands of the case. It releases and gives force to the general circulation, and increases the irritability of the extreme vessels. Phrenitis, pneumonia, or pleuritis, is the consequence. The physician is alarmed by the unexpected event; yet so like inflammation are the consecutive symptoms, that he ventures upon the lancet for their relief. But, the symptoms had followed upon the loss of blood, and his decision is restrained. He therefore stops at the very point of mischief, and adds another impulse to disease. He may yet bleed again and again, as the malady resists all other agents; but the same caution prevails, and the evil increases at every partial outlet of blood (*Note* p. 729).

These cases accumulate rapidly upon the hands of the unskillful or timid. Records are examined, and parallel examples are found to abound. Dissections are made, and reveal the usual physical signs of inflammation. The conclusion, therefore, comes up, as expressed by Dr. Hall, that there is a disease "exactly like inflammation, but totally different from it"!

Just so it is with child-bed women. There is often a great tendency, in these cases, to local inflammations; and these may be more or less speedily developed by moderate flooding, especially if there have been previous venous congestion, as is very frequently the case (§ 803, 965 *b*). Dr. Hall has many of these examples, and were they really cases of simple irritation, or simple exhaustion and excessive reaction from loss of blood, they could not be adduced to illustrate the effects of bloodletting in disease. They should form a class by themselves; designated as cases of the morbific effects of "excessive loss of blood" upon the comparatively healthy system. They must, therefore, be admitted to have no bearing upon cases where bloodletting may have been demanded, and to be worse than useless for illustrating the effects of bloodletting as a remedy. As well might one say, that cathartics shall not be given in disease, or only so with fear and trembling, because they may be pernicious in health. And he, being well, who should physic himself in order to be better, would be mad indeed should he attempt to remove the evils of his mistake by swallowing one dose after another. Just so it is in respect to bloodletting, or accidental hemorrhage, in health. If inflammation follow in the latter instance, it will be important to ascertain whether excessive

bloodletting have been the exciting cause, or whether it did not spring from a previous disposition to disease; since the treatment will be entirely different in the two cases. The former case is rare, as known from the accidental and profuse hemorrhages that are daily occurring. Nor is even simple irritation a common result; the injury consisting mainly in feebleness. And here I may say, that it is a remarkable fact, that the effects described by Dr. Hall as incident to lying-in women rarely supervene upon excessive flooding; thus showing that in the cases of disease the affection existed already, or was about taking place.

1023, *b*. When, however, inflammation is actually induced by excessive loss of blood, the effects of the physiological influences are different from those which I have set forth as constituting the philosophy of the operation of loss of blood, as the effects are morbific in one case, but are not so, or are curative, in others. The *modus operandi*, however, is exactly the same in all the cases; and, being so, the morbific effect confirms my philosophy of the modus operandi of the curative influences. In the former case, an injury is inflicted, suddenly, and severely, upon the *vires vitæ* of all parts, and the nervous influence is powerfully determined upon all. The brain suffers the impression particularly; and if "irritation," or "excessive reaction," follow, I know of no recorded instance which has not also presented the usual phenomena of inflammation, either in the brain or some other organ. If death ensue, effusions of serum, or of lymph, or disorganization, &c., are the concurring results. Still, however, another cause, and not the loss of blood, may have produced the disease, and have been overlooked, as is most probable (§ 1006).

1024, *a*. Dr. Hall, who, particularly, called our attention to the foregoing "irritation," and "excessive reaction," as frequent effects of excessive loss of blood, and distinguishes those conditions from inflammation, concedes that "exhaustion from loss of blood is not only not incompatible with repletion and a tendency to effusion within the head, but it actually supposes that condition of the encephalon, when long protracted." He also states that leeches to the head are one of the remedies. So, too, may general bloodletting relieve the symptoms, but only temporarily in the cases supposed; since, when inflammation is induced by an excessive loss of blood, such is the combined nature of the exciting cause and its curative effects the modified irritability of the vessels may readily yield, at the moment, to a farther loss, but will soon display the morbific influence (§ 901).

1024, *b*. In my remarks upon the physiological effects of bloodletting I endeavored to show that, when the loss of blood is carried to a state of syncope, and more especially to any injurious excess, the greatest severity of its influence is sustained by the brain (§ 950). It is to the head, then, that we should generally look for the local injury, if any attend the reputed cases of irritation and exhaustion from an excessive loss of blood. This is precisely what we find stated by the late writers who have treated of this subject; at least in a general sense.

1024, *c*. But, as the question under consideration is of no little practical importance, it may be well to have before us Dr. Hall's highly-descriptive account of the severe grades of what he calls "exhaustion with excessive reaction," and as supplying the most ample proof that

the supposed condition is, in reality, a state of active inflammation. Thus:

"The beating of the temples," says Dr. Hall, "is at length accompanied by a throbbing pain of the head, and the energies and sensibilities of the brain are morbidly augmented; sometimes there is intolerance of light, but still more frequently intolerance of noise and of disturbance of any kind, requiring stillness to be strictly enjoined, the knockers to be tied, and straw to be strewed along the pavement; the sleep is agitated by fearful dreams, and the patient is liable to awake or to be awoke in a state of great hurry of mind, sometimes almost approaching to delirium; occasionally even continued delirium; more frequently there are great noises in the head, as of singing, of crackers, of a storm, or a cataract; in some instances there are flashes of light; sometimes there is a sense of great pressure or tightness in one part or round the head, as if the skull were pressed by an iron nail, or bound by an iron hoop."

1024, *d.* Now, the foregoing symptoms, which Dr. Hall considers as denoting a state exactly *opposite* to that of inflammation when they attend considerable losses of blood, are precisely such as are characteristic of cerebral inflammation when induced by other causes. But, as if to remove all doubt as to this conclusion, this distinguished philosopher reiterates the foregoing account, and designates other phenomena not less significant of cerebral inflammation, such as "frequent delirium," "hardness of pulse," "buffy blood," &c.; and, to give to the subject its utmost force he calls to his aid the opinions of Cook, Coke, Kellie, Tweedie, Hammond, Cox, and others; all of whom agree in testifying to the symptoms that mark, exactly, the character of inflammation of the brain. Nay, more, he allows this conclusion,—that they are "attacks which resemble inflammation of the head, chest, or abdomen, and yet are *totally different* in their nature."

Thus then, as to our author's excellent description of the general phenomena, which he imputes to this disease that is considered so opposite to inflammation, they are, to my mind, conclusive against our author's doctrine.

1024, *e.* Morbid anatomy contributes, also, its corresponding proof. "The next point for our consideration, in the inquiry into the morbid effects of loss of blood," says Dr. Hall, "will be that of the organic changes induced during the state of sinking. These are chiefly observed in the brain, in the cavities of the serous membranes, in the bronchia, in the lungs, and in the track of the alimentary canal, under the forms of *effusion*, *œdema*, and tympanitis." At other times, our author admits of *morbid redness*, and absolute *disorganization*, as rapid consequences of this affection so opposite to inflammation.

1024, *f.* Such, indeed, is the entire coincidence between our author's supposed cases and those of inflammation, that we are told by the author that there is often no other test of their distinction than the treatment which is adapted to inflammation. We must bleed; and if the patient bear it well,—*well*;—if otherwise, we must then endeavor to repair the wrong. This after-knowledge, this dependence for the diagnosis upon the effects of treatment, may help the understanding; but will it be likely to help the patient, or to improve the science? And how is the treatment improved by this species of intelligence? The greatest zealot would abandon the diagnostic test

if he found it injurious. But, says Dr. Hall, the patient "may be greatly relieved by the loss of blood;" "the temporary relief which follows general bloodletting may be so uniform as to impose on the inexperienced." Then I maintain that the loss is useful.

1024, *g*. In the foregoing cases, as related by Dr. Hall, and others, where there had been bloodletting, we may generally recognize the occurrence of cerebral inflammation independently of the loss of blood, and often of its pre-existence; and I as sincerely believe that farther bloodletting was the proper remedy for the disease. In the cases where irritation, and excessive reaction, are said to have been consequent on spontaneous hemorrhage, it is not less apparent that, in most instances, inflammation had already existed, or there was a strong predisposition to it.

1025. There are few practitioners in the United States who have seen more of bloodletting than myself; and I am therefore quite conversant with cases of the foregoing nature, as I have met with them in the hands of others. In numerous instances where the attending physician had imagined "excessive reaction, and prostration from excessive loss of blood," I could discover nothing but the onward march of inflammation, that called for greater abstractions of blood; and that this opinion was right has been generally confirmed on resuming the depletive treatment.—*Note* p. 763.

1026. Finally, as I have said in the "Commentaries," the rules for bloodletting which have been propounded by Dr. Hall, and all others of a like nature, are captivating by their simplicity. This was the secret of the popularity of Brown's Elements of Medicine, and of the long, unmolested sway of the Humoral Pathology. A later and more universal example is seen in the chemical views of life and disease.

Many have imbibed an erroneous impression that Dr. Hall is a warm advocate for the use of the lancet; and, as the case of Dr. Hall is very extensively applicable to physicians, I shall state the nature of the misapprehension. Dr. Hall advocates bloodletting only in certain affections where few would deny the propriety of the remedy; and in such cases he commends its liberal use. But, what he has so far said with emphasis has the effect of discouraging its application in the vast class of congestive fevers, and depressing inflammations, and even in many of the cases to which, on general principles, he admits its applicability (Rights of Authors, p. 913, and *Index II*, art. Hall, M.).

But it is not alone by his exclusive precepts that his purpose is attempted. On more than one occasion he broadly affirms, that "it is difficult to say whether more injury has been done by an undue, or by an inefficient, use of the lancet." Such is the balance which is often struck by apparent advocates of bloodletting; but, I am still apt to think, with Botalli, that "One hundred thousand men perish from the want of bloodletting, or from its not being timely employed, where one perishes from excessive bleeding, when prescribed by a physician."

General Conclusions as to Bloodletting.

1027. From all that has been now said on the subject of bloodletting, I arrive at the following general conclusions:

1. That loss of blood produces its direct and efficient impression upon the *vires vitæ* of the capillary blood-vessels, by modifying their action.

2. That the quantity of blood to be abstracted relates directly to the foregoing impression.

3. That the most salutary effect of loss of blood will, therefore, consist in its nearest approximation to a full but just impression upon the *vires vitæ*.

4. That, to produce and maintain the foregoing impression will require the abstraction of a certain quantity of blood in every case, the measure of which will be the antecedent and resulting symptoms.

5. That bloodletting may add to the force of disease by coming short of that impression; or, it will be injurious if carried to excess, or may even induce new inflammations.

6. That bloodletting may be a remedy for other diseases than inflammation and fever.

7. That, when employed as a prophylactic, on passing from northern to tropical countries, it must be with such moderation as shall not increase irritability; and then only in the plethoric and robust.

8. That general bloodletting, cupping, and leeching, operate upon common principles, which are more or less modified in each mode of abstracting blood. That cupping is intermediate, in this respect, between general bloodletting and leeching.

9. That general bloodletting is a far more important remedy than leeching; and that, while cases constantly arise in which the latter cannot be substituted for the former, there are numerous instances in which general bloodletting cannot take the place of leeching. That cupping will sometimes answer the purposes of either, and may be, though rarely, better.

10. That the nervous system has a special and large allotment in the effects of loss of blood, and that loss of blood operates, in the first place, by inducing a profound effect upon the extreme blood-vessels when the influence thus exerted is propagated by sensitive fibres of the sympathetic or nerve of organic life upon the nervous centres, the nervous power excited, and then reflected through excito-motory fibres of that nerve upon the sanguiferous organs, and with a special alterative effect upon the susceptible capillary blood-vessels that may carry on the morbid process, that, when the vessels of the nervous centres contract, the reflex nervous influence is increased by the projection of a direct development of that influence upon the sanguiferous organs, and that these influences multiply in an increasing ratio till syncope takes place.

11. That in bloodletting five principal objects are contemplated: 1. To reduce the volume of blood. 2. To thus establish a change of action in the capillary blood-vessels. 3. To thus obtain the alterative action of the nervous influence. 4. To reduce the exciting nervous influence attendant on inflammation and fever, whether reflex or direct, that disease shall abate, and that cathartics, counter-irritants, &c., when necessary, may operate without exciting a morbific reflex nervous action. 5. To thus, also, prepare the way for other remedies by promoting their salutary effects and preventing their deleterious, which have equally a reference to the condition of the nervous influence.

12. That spontaneous hemorrhage, occurring at adult age, should not be restrained, unless manifestly proceeding to excess.

> "Truth, like a single point, escapes the sight,
> And claims attention to perceive it right;
> But what resembles truth is soon descried,
> Spreads like a surface, and expanded wide."—POMFRET.

APPENDIX.

PROGRESS OF "PHYSIOLOGICAL AND PATHOLOGICAL CHEMISTRY," OR "EXPERIMENTAL MEDICINE."

1028. During the former editions of the foregoing work the Author has seen no inducement to modify any of his conclusions, or to disturb any of the facts upon which they are founded, and, for the same reason, every statement appears in the present edition (1857) as presented originally in 1847. Whatever may have been subsequently disclosed in Physiology and Chemistry is essentially in harmony with all that the author incorporated in the foundation upon which his Institutes are erected, and places them beyond the probability of being much invalidated. In his discussion of Organic Chemistry as applied to Physiology, Pathology, and Therapeutics, it is evident that he could not doubt that this invasion upon Medicine would prove ephemeral, and that the Chemist would soon retreat into the appropriate field of Nature. (§ 4½ *d*, 5½–6, 18, 42–67, 349 *a*, 350¾ *n*, 351, 356, 376½, 435 *c*, 676 *b*, 960 *d*, 1006 *a*, &c.)

These expectations have been realized sooner than the author had anticipated, as he will now show, for the benefit of his junior readers, by a few extracts from one of the latest and most approved works upon Organic Chemistry, by the justly celebrated Professor Lehmann. It is true, our Author has favoured us with an able and elaborate Treatise in behalf of "Physiological Chemistry;" but whoever may peruse its pages will everywhere discern the obstacles which necessarily beset his path, and the vagueness of his conclusions, and many unavoidable contradictions, after having discarded those indispensable elements which are summarily involved in the following quotations, and which amount to a virtual admission that we must seek in the doctrines of vital solidism for the only true philosophy of life and disease. Thus, our Author:

1029. "As soon as we subject to investigation the highly complicated chemical phenomena of life, *we enter upon the actual domain of hypothesis.* It unfortunately happens, however, that the correct logical conception of an hypothesis has been completely lost sight of, and its place supplied by the vaguest fictions; whence the term has fallen into such discredit that many have been desirous of setting aside all hypotheses, unmindful that even the simplest form of experiment cannot be presented without their aid.

"Physiological Chemistry has given rise to many delusions of this nature, owing to its imperfect development, and to the necessity presented by Physiology and Pathology for chemical elucidation. Some few isolated deductions were drawn from superficial chemical experiments, and arranged in a purely imaginary connection by the aid of chemical symbols and formulæ, for whose establishment analysis in many cases did not afford any sanction. Thus, for instance [a very important and comprehensive example], in the attempt to form a conclusion regarding the meta-

morphosis of the blood from an elementary analysis of its solid residue, and of the composition of the individual constituents of the excretions, there is an utter absence of all scientific groundwork; for, independently of the fact that the elementary analysis of so compound a matter as the blood is *incapable of yielding any reliable results*, and cannot, therefore, justify the adoption of any special chemical formula, it is surely most illogical to attempt to compare the composition of the blood collectively with that of the *separate* excrementitious matter. In such deductions, expressed by chemical formulæ, the addition of atoms of oxygen, and the subtraction of those of water, carbonic acid, and ammonia, *are wholly arbitrary*, for chemical analyses do not afford the *slightest grounds* for the majority of these equations."* "Chemical equations having no other foundation than the presumed infallibility of empyrical formulæ, must cause us to deviate from the path of physical inquiry, and involve us in a chaos of the most untenable delusions." (*Vide* LIEBIG § 50, 409 *b*).

"Have the *numerous analyses of morbid blood* instituted during the last few years fulfilled the expectations of Physicians? (§ 5½, *a*.) With all due gratitude to the indefatigable investigators who, with no other aid than that which zoo-chemistry could offer, boldly attempted to throw light on those obscure inquiries, it must be admitted that, when we seriously inquire into the *recompense of all their labors* and sacrifices, we find that the result, although too dearly bought, was *altogether inadequate to satisfy the requirements of Pathology.* (§ 376½.) Have the numerous analyses of the *urine* led to *much more than the assumption* of several new species of disease, or so-called diatheses? (§ 427, 691.) Although we might have anticipated greater results, we can hardly wonder that the efforts hitherto made should either wholly or partially have deceived our expectations; for although these investigations may have rendered chemistry no unworthy auxiliary to a physical diagnosis, *analyses of morbid products can hardly afford an insight into the chemical laboratory of the organism*, while the means are wanting to prosecute them with the scientific accuracy attainable in the case of mineral analyses. Animal Chemistry is still *wholly unable* to afford us a precise, and at the same time a practically useful method of investigating the *blood;* and how should it be otherwise while we continue to be in doubt regarding the chemical nature of *its ordinary constituents?* The mineral substances of *normal blood* are not yet determined, or, at all events, continue to be made the subject of dispute; we scarcely know the names of the fatty matters it contains; one of its most important constituents, *fibrin*, cannot be chemically exhibited in a pure state; we are ignorant of the *nature* and mode of secretion of the *globulin* of the blood-corpuscles; we are still far from being able to separate and determine the so-called *protein oxides* (§ 18, 53 *c*, 409 *a*, *b*); and we are also ignorant of the excrementitious substances occurring in the blood. *How, then, amidst these* and a THOUSAND OTHER UNCERTAINTIES AND DOUBTS, *can an investigation of the blood be scientifically and trustworthily conducted?* We analyze healthy and morbid *milk*, and yet we are ignorant of the substances whose admixture we have termed *casein.* The *urine*, in its morbid conditions, presents many varieties; and yet our knowledge of that secretion, frequently as it has been analyzed, *amounts to little more* than an acquaintance with the quantitive relations of *some of its principal* constituents; *creatinine* and *hippuric acid* have not been determined by any analysis, while absolutely nothing is known regarding the most important pigment of this secretion.

* This sustains my criticism of LIEBIG, p. 221-222, § 409 *b*.

Many experiments have been made and theories broached on *nutrition* and *digestion*, and yet to almost the present day the existence of *lactic acid* in the gastric juice has been contested. Although hypotheses are not wanting regarding the mode of action of PEPSIN, *we know nothing of its nature* (§ 363–365), and we are *wholly ignorant* of the proximate metamorphosis of albuminous bodies in the stomach during digestion. Will Mülder be able, even with his most accurate analyses, to support his *protein* theory by the aid of sulphamide and phosphamide? Or is *this term* destined to indicate a *past epoch* of Organic Chemistry? (§ 38–51, 350¾ *n*, 376½, 409 *a*, *b*.) *When such is the state of Organic Chemistry*, can we wonder that there should be *obscurity* regarding the chemical processes in the animal body, their various isolated and combined actions, their casual connection, and their dependence on external influences and internal conditions? Unfortunately, we might be led to believe, from the lectures and writings of many physicians, that, *trusting* to the aphoristic and often highly apodictic assertions of certain chemists, they felt secure of having reached the object of their inquiries. (§ 5½, *a*.) Although *at present* LITTLE MORE THAN THE DIRECTION is indicated, *we may hope in due time, and after innumerable efforts, to see our endeavours crowned with success!*" And so said Fourcroy seventy years ago, p. 9, § 5, 376½. From all which, it appears that our friends are upon the wrong track.—Professor LEHMANN'S *Physiological Chemistry*, vol. i., p. 19, 23, Philadelphia, 1855.

1030. Again, we have a summary admission from this eminent Chemist which shows us forcibly that there can be no dependence upon organic analyses for any knowledge of the natural or morbid processes or products of the living body—not even, indeed, of the elementary constitution of the tissues in their natural condition. Thus:

"The theory of the chemical nature of the animal tissues is a department of physiological chemistry which, as yet, has been very little cultivated, and the reasons of this unsatisfactory state of our knowledge are too obvious to require any detailed exposition. We will, therefore, simply observe, that the most important obstacle to the chemical investigation of the tissues is, that their elements are too intimately combined or associated with one another *to admit of their being prepared* for chemical analysis by a previous mechanical separation. This separation of the various elementary tissues which are deposited among, penetrate between, and envelop each other, is rendered the more difficult by the circumstance that, with scarcely an exception, they are equally *insoluble* in the ordinary indifferent menstrua employed by chemists. If we have recourse to the stronger or more energetic solvents, as, for instance, acids and alkalies, we have seldom *any assurance* that the dissolved substance is the, otherwise, *unchanged* histological element, and the portion remaining undissolved is, in reality, a simple chemically pure material. Indeed, in a majority of cases, there cannot be a doubt that the chemical constitution of the tissue on which we are experimenting is *entirely changed by such reagents*" (§ 53 *b*, 417 *a*). And so of the blood and secretions, § 1029. (Professor LEHMANN'S *Physiological Chemistry*, vol. ii., p. 174.)

Among the many very luminous comments by which our author discredits organic analyses we should naturally expect to find the same discouragement of pathological chemistry. On entering upon the consideration of "Exudations and Pathological Formations," he remarks that,

"We have often had occasion to comment upon the inefficiency and imperfection of our chemical knowledge, when compared with the *great expectations* which have been entertained in respect to its applications to Physiology and Pathology; yet there is scarcely any subject which *more thoroughly calls for our confession of weakness and incapacity* than the one we are now about to consider" (§ 5, 376½, 676 *b*, 1006 *a*). Again: "The science of Pathological Histology, which alone can guide the Chemist, *is so full of uncertainties, subjective conceptions, and varying conjectures*, notwithstanding some signal advances, that it scarcely ever presents any starting-point for chemical investigation."—"A Chemist cannot be satisfied that he knows a substance until he has submitted it to an *elementary analysis*, and can attain, at all events, an approximate determination of its atomic weight. In fact, a body which has been submitted by the Chemist to a few reactions only, however striking they may be, but for which he is unable to establish *a formula based upon elementary analysis*, may be almost considered as *unknown to him* (§ 1029). In this sense (and in exact investigations we can only take this view) all substances, as transition stages from the protein-bodies of a plastic exudation, are *wholly unknown to us*, and must remain equally unexplained until we are able to elucidate the *mystery of protein*" (§ 18 *d*, *e*, 53 *b*, 409 *a*, *b*). The troubles multiply after death, among which is the "rapid decomposition, even while the body is yet warm," and upon which we have quoted a luminous remark of Tiedemann in § 54, *a*. "In a word," says our Author, "while even the quantitative investigation of objects derived from healthy animals has to contend with such difficulties that very few animal juices admit of being very accurately examined, the *qualitative* analysis of pathological products *is opposed by insuperable obstacles*." "If, therefore, we have *very slight prospect* of being able to trace pathological processes by a *qualitative* examination of exudations, or of attaining any scientific aim by such a mode of procedure, we are led to inquire, *with some hesitation*, whether the *quantitative* analysis of these products would be attended by any better results."—LEHMANN, *ibid.*, vol. ii., p. 271–274.

I have taken the liberty of placing many of our Author's words in italics and capitals, and have introduced references to Sections in these Institutes, and shall preserve this plan hereafter for the sake of the reader's eye, and, more or less, as a substitute for comment. Many of the remarks which I have rendered emphatic in all the foregoing quotations express a fundamental fact, which vitiates all organic analyses beyond the mere disclosure of a probable elementary composition. Upon this I have hitherto insisted as an insuperable difficulty (§ 53, *b*, &c.). I may also say, in explanation of my general silence upon our Author's facts and hypotheses, that I am not aware of any one whose essential nature I have not examined and controverted in the foregoing work. But a better reason may be found in the consideration that our Author has, himself, surrounded his facts and hypotheses, throughout his work, with admitted doubts, distrust, and ambiguities, of which the foregoing are but a few examples. It is, however, an able, but, as appears to me, an abortive attempt to reconstruct the fallen fabric of Organic Chemistry. Our Author is merciless upon the past, and, as our extracts show, is almost hopeless for the future (§ 626 *b*, 819 *b*, and *Notes*, pp. 196, 911).

PRODUCTION OF ANIMAL SUGAR.

1031, *a.* It is now my purpose to bring under the test of the foregoing results of chemical experience, as well of certain physiological principles, the new function which has been lately ascribed to the liver of generating sugar, in connection with the supposed mechanical filtration of sugar from the blood by the kidneys and mammæ. But, independently of this great incongruity between the supposed catalytic action of the liver and the mechanical office of other complex glandular organs, we are startled with the announcement that the liver is a farther exception to the principle of analogy in discharging multiplied and perfectly distinct functions in the economy of life. "Qu'il résulte de là que le foie n'est pas un organe simple, mais un organe à fonctions multiples, puisqu'il sécrète d'une part du sucre, de l'autre de la bile."—CL. BERNARD, *Leçons de Physiologie Exp.*, &c., p. 88; 1854, 1855.

Without, certainly, denying the alleged fact in respect to the liver, it is proper to inquire into its probability until it becomes established, and in doing this we shall have analyzed some important facts in their relation to the functions of glandular organs. Should the supposed formation of sugar by the liver, as a product distinct from the bile, and destined to subserve totally different purposes, be rendered no longer doubtful, we shall hail it as a remarkable accession to physiological science, however much it may disturb any supposed principles, or however little may be its practical bearings; and, whatever may be the final issue, nothing can detract from the great merit of the inquiries which conducted the philosopher to the supposed discovery. (§ $5\frac{1}{2}$, *a–f.*) Our argument, however, will be particularly with Professor Lehmann, who has gone more fully than Bernard into many important bearings of the question.

1031, *b.* Now, in respect to the production of bile, Professor Lehmann is a perfectly orthodox Physiologist; but, apparently, only so because the reagents employed in Chemistry have not yet transformed the constituents of blood into any of those so-called proximates which they so readily effect in the bile. (§ 54 *a*, 1029, 1030.) Doubtless, however, when that shall have been consummated, as is not unlikely to happen, the liver will lose its isolated rank in Physiology, and fall to the level of other "strainers." Thus, our Author:

"In passing to the consideration of the individual biliary substances, and inquiring which of these exist *preformed* in the blood of the portal vein, we find that *none* of the most essential constituents of the bile can be detected in it." "The error of supposing that biliary substances have been demonstrated in the blood of the portal vein by means of sugar and sulphuric acid, arises from the *similar reaction* which Pettenkofer's test gives with olein and oleic acid."—LEHMANN, *ibid.*, vol. i., p. 480. Our author says, also, that "During the slow passage of the blood through the liver, it undergoes such important modifications, that a mere *filtering off* of certain constituents of the blood through the liver *is not to be thought of.*" And so Müller, § 42, and Mülder, § $350\frac{3}{4}$ *e*, and Liebig, § 53 *c*, 409 *b*.

It is even denied by Kane and others, that the bile is absorbed into the blood in cases of jaundice—only the coloring matter. "The problem," say Becquerel and Rodier, "as to whether the bile passes into the blood has occupied the attention of Chemists as well as Physicians, but

it does not appear to have been thoroughly solved by either."—Becquerel and Rodier's *Pathological Chemistry*, p. 239. London, 1857.

As to *lactic acid* and *urea*, Lehmann declares that "The recognition of lactates in healthy blood is just as difficult or *impossible* as that of *urea* in the same fluid."—(*Ibid.*, vol. i., p. 96.) The supposed pre-existence of Liebig's "important instrument," *protein*, in the blood (§ 18 *c*, 409), and of the great digester, *pepsin*, also, is abandoned; which, indeed, may be equally said of most other organic products.

Now, in these facts which Chemistry has been gradually learning in its career of "experimental philosophy" it should recognize a very strong analogy in proof that the formation of all the secreted products of an organic nature, and in the natural condition of the body, depends upon the organs by which they are elaborated, and that they had no pre-existence in the blood. The various modifications which *lymph* undergoes, as deposited by the most simple structures in different parts of the body, reflects a flood of light upon our subject (§ 408, 409 *e–h*); and I may appeal to Liebig for a great general law which carries our analogy through all organic nature (§ 42). The analogy, however, supplied by the simple tissues should be at least conceded to the glandular organs, since it is here corroborated by a strict analogy of structure; and where chemical reagents determine from the blood the same so-called proximates which they are capable of deriving from the secretions, these supposed proximates should be regarded equally as artificial transformations (§ 43, 53 *b*, 54 *b*, 417, 1030), and Organic Chemistry should cling to *catalysis* as its only consistent and dignified ground (§ 350¾ *a–g*, 409 *j*). But such has never been the philosophy of Organic Chemistry. It discards, ostensibly, the organic force, or vital principle, or plastic power (for they are convertible terms), while there is scarcely a modern treatise upon chemical physiology which does not invoke the aid of that power in its lucubrations upon the phenomena of life, and then with senseless ingratitude casts it away as a phantom of the imagination; though it should be excepted in behalf of Lehmann that he is consistent throughout in disclaiming all connection with any thing but the mere properties of dead matter. It is not, therefore, remarkable that, when these philosophers manufacture sugar or urea out of the blood they should neglect their pronunciation relative to the constituents of the bile. Our able Author is of this number, although he finds much difficulty with diabetic urine. But this is partially overcome by the assumption that "no one can doubt that it is, for the most part at all events, *derived from vegetable food*."—(Lehmann, *ibid.*, vol. i., p. 259.) And "M. Mialhe, especially, believes that the formation of sugar can not be independent of a saccharine or amylaceous diet."—(Becquerel and Rodier, *ibid.*, p. 249.) No one, however, acquainted with the literature of medicine is ignorant of the fact that the saccharine matter in diabetes is said to be often as abundant when the patient subsists as exclusively upon animal as vegetable food, and that there are those who have considered a vegetable diet most conducive to the disappearance of saccharine matter in diabetes. (See Essay on the Philosophy of Diabetes, in *Medical and Physiological Commentaries*, vol. i., p. 674–682 (1840), where this ground is considered, and where the Author anticipates the ultimate failure of detecting sugar and urea in the general circulating mass of blood, in opposition to the statements then in vogue; or, as Christison had it, the blood is sometimes "loaded with urea." Also, § 1007 *c*).

Nor can the laboratory approach an intelligible answer why such a profusion of saccharine matter is elaborated during lactation, unless it be allowed to be the product of the mammary gland (§ 424). Whence comes this substance in the nursing-mothers of the human race that are wholly restricted to a meat diet, as in dyspeptic troubles, if vegetable food, as is admitted (ut supra), must yield, "for the most part at all events," that substance to diabetic urine? Or where shall we look for it in the nursing-mothers of the strictly carnivorous tribes? Will the laboratory answer why saccharine matter is not accumulated in the blood when lactation is suppressed? Or if, according to Bernard, sugar be found throughout the circulating mass of blood during digestion, why is not some small part of it at least "strained off," as in diabetes? According to this Philosopher, when it gets involved in the circulating mass, it must be an effete substance, since it is said to be generated by the liver to be extinguished in the lungs for the uses of the general economy. Nor will it do to assume that the quantity is too small; for it appears to be far more easy of detection by Bernard in the blood of the renal arteries than urea can possibly be under any circumstances. The fact, therefore, contradicts the experiments. Moreover, is it probable that the same disposition would be made of sugar by the lungs when circulating in arterial blood as when presented to those organs by the venous blood of the hepatic veins? (§ 409, *e.*) No incongruous hypotheses will answer here; and it is evident that the Chemist would avoid the inquiry. (See LEHMANN, *ut cit.*, vol. ii., p. 344.)

It is true, it made no difference with Cl. Bernard (who, doubtless, had the foregoing facts before him) whether animals were fed upon vegetable or animal food. He was always sure to find sugar somewhere between the liver and the lungs, or, at all events, in the supposed laboratory itself. But we will hear him:

"We fed a great number of dogs, at the College of France, during six or eight months exclusively with meat. The animals being then killed, 1·90 gr. of sugar was found in the liver, and this is as large a proportion as is found in dogs that have been allowed a mixed diet (*l'alimentation mixte*)".—BERNARD'S *Leçons de Physiologie Exp., appliq. à la Médicine*, p. 69. 1854–5.

Bernard also allows the fact (important in its connection with the foregoing), that long abstinence occasions an entire failure of the production of sugar. Nor did he find it in any of the cases beyond the precincts of the liver, which farther embarrasses the phenomenon of lactation in carnivorous animals, and of diabetic sugar as it presents itself in man when subsisting upon animal food alone. Moreover, Bernard failed of detecting sugar in the liver of some diabetic patients, which leads Becquerel and Rodier to say that,

"The theory of Bernard, although bearing the stamp of probability, presents, nevertheless, certain difficulties which farther experiment can alone remove. As long as the absence of sugar in the livers of a certain number of diabetic patients remains unexplained, his theory must be regarded as incomplete."—BECQUEREL AND RODIER, *ibid.*, p. 249.

Nevertheless, there appears to us no difficulty in accounting for the production of sugar either by the mammæ in lactation, or by the kidneys in diabetes, although the subjects subsist exclusively upon animal food, or be subjected to prolonged abstinence. *Glucose* or grape sugar, which is said to be identical with *diabetic sugar*, consists of twelve atoms each

of carbon, hydrogen, and oxygen. These are the main constituents of the blood, whatever the diet; and if the Chemist fail of fabricating sugar out of the blood or liver after prolonged abstinence, it does not show in the least that it may not be generated by some part of the living organism. But it does show that Organic Chemistry is at fault in its premises when it confounds the living body with a chemical apparatus. Well, therefore, has it been said, when chemically considered, that

"M. Bernard, while asserting that the liver may secrete sugar without the ingesta of such alimentary substances as are usually considered necessary to its formation, nevertheless admits that prolonged abstinence may even produce complete disappearance of the sugar. This result—the formation of sugar without constituent materials—is the most unacceptable portion of his theory, and new experiments are requisite before it can be satisfactorily proved."—BECQUEREL AND RODIER'S *Pathological Chemistry*, p. 248.

Nor is it a less interesting feature of the subject, that the liver should be regarded as the producer of saccharine matter in virtue of its organization and properties, both by Bernard (*ut cit.*) and by Lehmann (*ut cit.*, vol. i., p. 257, 624; vol. ii., p. 344), as, also, of the bile, while the mammary gland in fulfilling its wonderful final cause, alike in all its variety of structure, and the kidney in a special form of disease, are degraded to the mere mechanical office of filtration. (§ 408, 424.) I need not speak of the dormant condition of the former gland in all mammiferous animals in the absence of maternal relations, but may say that, according to Lehmann, "in a normal state it is probable that no sugar *finds its way* into the urine" (§ 829), and that "it is only seldom we meet with saccharine matter in other diseases than diabetes;" and even "in the blood of diabetic patients, I never could find," says Lehmann, "more than 0·047 p. m. of sugar;" (*ut cit.*, vol. i., p. 257, 623.) Becquerel and Rodier go farther than this:

"The *only* disease," say they, "in which it has been found is diabetes; and in this its presence has given rise to so much difference of opinion, that doubts remain in the minds of many respecting it. It is certainly, however, found in *no other* disease. Among the thousands of specimens of serum which we have examined, it has *never been once* detected; nor has any other Chemist alluded to its presence except in diabetes. But even in this disease, its existence in the blood has been considered doubtful, and is even *denied* by some Chemists—Guendeville, Vauquelin, Segelas, Wollaston, and Henry." And, as to the test of light, "it is as the result of upwards of a thousand analyses of the blood by means of the polarimeter, that we feel authorized to affirm, that if sugar exists in the blood of persons suffering from other diseases than diabetes, *the fact is extremely rare and exceptional.*"—BECQUEREL AND RODIER'S *Pathological Chemistry*, p. 71, 72.

It appears, therefore, that Organic Chemistry has receded to about the conclusions which we adopted upon physiological grounds seventeen years ago, and fortified by the observations of a distinguished Chemist of that day, whom we quoted in the *Medical and Physiological Commentaries* (vol. i., p. 674), in the following manner, and to which we now refer in behalf of vital solidism. Thus, the Commentaries:

Mr. Kane has stepped forward in behalf of the dignity of chemical science, and it is to such philosophers that an "acknowledgment" is due from Physiologists. In respect to the blood of diabetes, he remarks,

that, "the results of these analyses show that in diabetes, the relative proportions of the organic principles remain quite within the limits of the composition of the blood in *perfect health.* In fact, the blood cannot, as far as these experiments go, be considered as at all affected in this distressing malady."—KANE, *in Dublin Journ. of Med. and Chem. Science*, vol. i., p. 24 (Compare with ℈ $5\frac{1}{2}$ *a*, 847 *a*, 1007 *c*).

But, however this may be, it cannot be doubted that, in the multitudinous experiments which are made with chemical reagents, some process may be found which is capable of generating from the blood a transformation more or less analogous to saccharine matter. Upon the whole ground, also, of the chemical philosophy of organic products, no objection can be alleged against our conclusion; since, if the formation of sugar in the vegetable and animal organism be a chemical phenomenon, nothing would be more likely than its manufacture by the Chemist out of other organic compounds having the requisite elements, though this conclusion is very far from showing the accuracy of the former. But, it is far more important to science and philosophy, and especially to practical medicine, that we have Lehmann's authority for saying that these analyses cannot be trusted. (§ 1029, 1030.)

§ 1032, *a.* Let us now consider the question in connection with urea. We have seen that Lehmann states that "the recognition of lactates in healthy blood is just as difficult or *impossible* as that of *urea* in the same fluid" (§ 1031); and he remarks that "many Chemists have long sought in vain to detect urea in normal blood; Simon believed that he had found it in calves' blood, and Strahl and Lieberkuhn, and recently Garrod, maintain that they have detected it in human blood. Without doubting the correctness of these Chemists, *it is only recently* that I have been able to convince myself by decisive experiments that urea is present in normal blood."—(LEHMANN, *ut cit.*, vol. i., p. 153.) But may it not have been an artificial product? (§ 417, 1029.)

Becquerel and Rodier remark that "urea probably exists in healthy blood, but in too small a quantity to be discovered by chemical analyses." This conjecture arises from the supposed discovery of urea in the blood by Prevost and Dumas after extirpating the kidneys of animals, and from its discovery by some Chemists, "chiefly in Great Britain," in Bright's disease. But Becquerel and Rodier have failed of detecting it in that affection. The question is then propounded—

"Does the same thing occur, however, when, from any other cause, the urinary secretion is greatly diminished, as in retention of urine, and in the various diseases to which the kidney is liable? On this subject, analysis is as yet silent; and here, as in Bright's disease, much remains to be done." (See cases of both in *Med. and Phys. Comm.*, vol. i., p. 601, *n.*).

As to the prevailing prejudice which often refers cerebral disorders to a *urea-diathesis*, these Authors remark that

"It has indeed been asserted that when the accumulation (of urea) became considerable, we might attribute to it those cerebral symptoms which are commonly met with in the last stage of many renal diseases. This may possibly be the case, but it altogether remains to be proved." And, as to *kiestine*, which has become ingrafted upon the philosophy of pregnancy, it is now said by Becquerel and Rodier that "*this discovery is a pure illusion.*"—BECQUEREL AND RODIER, *ibid.*, p. 70, 353. (See *Medical and Physiological Commentaries*, article *Humoral Pathology*, where objections are brought against the supposed absorption of urine in cases of suppression.)—NOTE Z p. 1130, an explanation of *uræmia.*

But Lehmann has finally succeeded in elaborating urea from healthy blood, and therefore again violates the analogy both of function and organization which he ascribes to the liver, of which he affirms "that a mere *filtering off* of certain constituents of the blood through the liver is *not to be thought of*;" and although, "like Becquerel, he has failed in establishing the fact that there is an augmentation of urea in certain forms of disease, although English physicians have shown *an inclination to assume* a urea diathesis" (*uræmia*), yet, having finally elaborated urea out of the blood, he neglects not only his own forcible analogy, but the fact that urea is readily formed in the laboratory, in a variety of ways, especially by transformations of cyanite of ammonia and of urine; and, therefore, not only overleaps the clearest induction from the premises that chemical reagents may, at least, accomplish the same artificial result when brought to act upon blood (§ 53, *c; Liebig*), but, in common with other distinguished Chemists, is led to regard the kidney as a mere *strainer*. (§ 409 *e*, 422, 423.) Whether, however, "catalysis," or the philosophy of "strainage" be adopted, before either can prevail beyond a mechanical age, they must answer us, in some slightly intelligible manner, how it happens, in conformity with the known facts of either Chemistry or Mechanics, that the urine undergoes such sudden augmentations from the operation of *fear* and from the contact of *cold air* with the surface of the body (§ 246, 422, 892¾); and why, also, the milk is liable to sudden and remarkable changes from mental emotions. But this would be of very little importance were it confined to the source in which it originated. Our Author, however, has contributed a good part toward assigning to the liver its proper rank in nature—abating the catalytic doctrine of its *modus operandi;* and it may therefore be reasonably expected that the time is near when the contrast in function between the liver and testis on the one part, and the mamma and kidney on the other, as now presented for the government of medical philosophy, will turn the attention of Physicians from the dogmas of the Laboratory, and the analogies drawn from "Strainers," to the study of living nature, and end in restoring Physiology to its proper cultivators. (§ 4½ *d*, 376½, 409 *i*, 493 *d*.)

1032, *b*. It is true, the kidney is an organ of excretion, and may, therefore, eliminate any foreign matter from the blood, though not by filtration. We do not deny that effete organic compounds, even sugar if it stray through the lacteals in morbid states (§ 192, 277–295, 826–827), may be eliminated more or less unchanged by the kidneys; though, for reasons already assigned (§ 38–51, &c.), this fact cannot be satisfactorily determined, either as to the blood or urine, by chemical reagents; and for this, too, we have the authority of Lehmann, Liebig, and Mülder. (§ 42, 53 *c*, 450¾ *e*, 409 *j*, 1029.) But *urea* is not introduced from without, and holds the same relation to the urine as *cholesterin* and the *resinous principle* do to the bile, if we allow these and urea to exist naturally in the conditions in which they are presented after the application of chemical reagents. (§ 53 *b*, 417 *a*, 1029, 1033.) But it is quite otherwise, in the former respect, with saccharine matter, which abounds in vegetable food. If this, therefore, were not destined for the nutrition of animals, and underwent no change in the process of digestion, it should, like any other foreign substance, be freely eliminated, in the same or some modified condition, by the kidney. But the general failure of detecting it in the circulating mass of blood, in connection with the great

amount which is appropriated by man and herbivorous animals, and its great abundance in milk and diabetic urine, and its absence in all but diabetic urine assure us of two facts, namely, that it does not enter the circulation unchanged, in healthy states of the body (§ 192, 277–295, 826–827), and that the mammary gland is capable, under certain very remarkable physiological influences, and the kidney in a special form of disease, of recombining its elements into saccharine matter, whether those elements exist in intimate union with the blood, or be derived from the disintegration of the tissues. But in morbid states of the digestive organs, as always attend diabetes, it might be supposed that saccharine matter would be readily taken up by the lacteals, when, like any other effete substance, it should be excreted by the kidney in some shape or other (§ 192, 277–295, 426, 826–827). It is certainly a remarkable coincidence that the mamma and kidney should, in special conditions of those organs, and in such conditions only (§ 424, 426, 427), be alike capable of forming saccharine matter out of the blood. But this is entirely less remarkable than the double function assigned to the liver of generating bile and sugar for important uses in the animal economy. Nevertheless, while the former circumstance disproves the physical rationale of filtration, it is more improbable that the mamma and kidney, under those special conditions, and those only, should alike become "strainers" of a substance which is admitted to exist in a greatly insufficient amount, at most, in the circulating mass of blood. It is also, I repeat, a far more probable hypothesis, that the kidney should produce sugar out of certain elements of the blood in that remarkable affection known as diabetes mellitus, than that the liver should not only perform habitually the two great functions of generating bile and sugar (the one for important uses in digestion, and the other for nutrition), but that its saccharine function should be abnormally increased in diabetes and also when required by the exigencies of lactation, and then applied to that specific purpose—and when, also, there is a special gland provided for the generation of milk.* Let it be considered, too, that the formation of sugar by the mammary gland has no reference to the internal economy, but, totally unlike the uses attributed to sugar as supposed to be generated by the liver, it is destined to undergo the same process of digestion as the sugar which is supplied by plants. Now, these are principles which can be set aside only by absolute demonstration (§ 1086).

Moreover, in diabetes the condition of the urine is remarkably altered in other respects, especially in regard to quantity; and the quantity alone denotes an essential change in the natural function of the kidney. And it may be said farther, for the sake of the analogy, that in morbid conditions of all organs, indeed of all parts of the body, and according to the nature of the malady, the secreted products are diverted from their natural character. This is even strongly exemplified in the various phases of common inflammation, and not less remarkably in the specific forms of that disease (§ 733, 740–741, 653 *c*). And again, I say, since it is allowed that sugar is not absorbed by the veins or lacteals, it would be clearly a foreign substance if intermingled with the circulating mass of blood, and would be at once excreted by the kidneys, and, therefore, in lactation, were the sugar generated by the liver, it should not go by way of the mammary gland. It appears to me that Nature is not so

* "Crystallized milk-sugar has exactly the same empyrical formula as anhydrous glucose, so that it therefore contains equal equivalents of carbon, hydrogen, and oxygen."

inconsistent as to justify the supposition that she has provided against the entrance of sugar, unchanged, into the general circulation, and at the same time has constituted the liver, or any other part, with a view to the reproduction in the torrent of the blood of what she has so carefully excluded in her arrangements for supplying the requisite means of nutrition—and this, more especially, as she has provided the mammary gland for the generation, in part, of saccharine matter, though not to be confounded with the torrent of blood, but to undergo transformation in the stomach.* Or why, again, has she so completely provided for the metamorphosis of sugar in the alimentary canal, if it is to be at once regenerated by the liver (§ 409, *b*–411); and thus, also, impose upon this organ, in violation of all her analogies, two perfectly distinct functions for the generation of products of fundamental uses in the animal economy, and whose uses, respectively, are perfectly distinct from each other? It will be no answer to say that, in ordinary states of the body the hepatic sugar is at once disposed of in the lungs; for, besides the fundamental objections already made, this hepatic sugar is supposed, in lactation, to be partly diverted from its great physiological purpose to supply means of nutrition to an external subject, which has no more relation to the individual than the plant has to the stomach! Or, if we glance at diabetes, there is the same inconsistency there. And yet another objection may be seen in another violation of analogies, in supposing that a glandular organ pours into the torrent of the circulation one of its most important products, while another not less specific takes the ordinary course toward open surfaces (§ 417).—Notes N R pp. 1121, 1123.

Cl. Bernard appears to be aware of the inharmonious nature of the new function which he has assigned to the liver with that of the production of bile. "Is it probable," he says, "that the albuminous substances of the blood, on reaching the hepatic cells, separate into two compounds, a hydrocarbon, destined to form sugar, and a nitrogenous one for bile? If this were so, these two compounds would be formed at the same moment." Bernard thinks, therefore, that "his experiments seem to denote that the formation of sugar and bile does not take place simultaneously, but that they *alternate* with each other." (*Leçons, ut cit.*) But this will not correspond with the consistent philosophy of organic life. It is also worthy of remark that Bernard's explanation of the disposition of the supposed hepatic sugar in the lungs is very unsatisfactory, even in a chemical sense; and, farther, that there is scarcely any agreement between him and Lehmann as to the uses of sugar in the animal economy (§ 83, 316, 409 *f*, *i*, 419 *b*, 423, 424).

I shall now introduce a paragraph which denotes the course of argument pursued in the Medical and Physiological Commentaries upon the questions before us:

When the secretion of milk is suppressed, I have there said, do we find that the saccharine matter is accumulated in the blood, or do we find *a trace of it there*, or is its secretion "replaced" by any other part? Or, shall we go on believing with Puzas, Leveret, Sauvages, Van Swieten, Selle, Astruc, Raulin, and many others, that it is generated by the legs, and forms the proximate cause of phlegmasia dolens? Or, when the secretion of bile is suspended, do its peculiar constituents appear in the blood, or their elaboration devolve upon any other part? We have shown that it is not so. Would you believe the oath of any one who might swear that he had detected semen in the blood, or in the saliva of

* Notwithstanding the exigency of digestion, even educated physicians (except in *physiology*) apply butter, &c., to the skin as a means of nourishment (§ 1088 *b*–*d*)!

a female? And yet it is affirmed to exist in the blood. (See *note*, p. 589. Also, this work, § 83, *b*, *note.*) Shall we admit that the virus of the rattlesnake, the viper, the bee, &c., exists in the blood? If the viper and rattlesnake die after the removal of their venom-glands, it is far from proving that it is in consequence of an accumulation of their specific virus in the blood. It is the same logic here as it has been with urea after extirpating the kidneys. Do we find the peculiar odor of the skunk, of the beaver, of the musk, &c., in the blood? Thus might we go on with a thousand different formations, which, if admitted to exist in the blood, would, of course, assign to this fluid as many component parts. But if, on the other hand, it be absurd to suppose that the latter formations do not depend upon their peculiar emunctories, why is it not equally so to imagine that animal sugar, urea, or cholesterine, &c., are merely strained off from the blood? (§ 409, *e.*) Finally, as to urea, about which humoralism has been so much concerned in the philosophy of diabetes, we may say, that Le Canu, whose analysis of the blood is admitted to be the best, agrees with former Chemists in denying its natural existence in that fluid.—*Med. and Phys. Comm.*, vol. i., p. 680. 1840.

§ 1032, *c.* If, however, the validity of the experiments by which saccharine matter and urea are said to have been obtained by analyses of the blood, and of other parts, be admitted, there is not much difficulty in interpreting the supposed results in conformity with a standard supplied by "experimental philosophy"—not even the curious phenomenon declared by Bernard of the existence of sugar in all parts of the circulation during digestion, but its subsequent limitation to the blood between the liver and the lungs. (§ 48, 49, 53 *c*, &c., *Liebig;* 350$\frac{3}{4}$ *e*, *f*, *Mülder;* 1029, *Lehmann.*)

The blood is so constantly fluctuating in its effete materials (§ 426, 427), that they may be regarded as taking an important part in the transformations, either contributing directly to the artificial formation, or exercising predisposing affinities upon the elements of the blood, when chemical reagents are brought into action upon this fluid (§ 6, 54 *a*); and, if we now consult the foregoing references, we shall find the most eminent Chemists virtually coinciding in this opinion. But I may quote the more specific, and later authority of Lehmann, which I shall do in the language of a Reviewer, for the sake of some other statements which occur in the same connection. Thus:

"It is a doctrine generally accepted by the Physiologists of the present day, that the glandular organ furnishes nothing to the secretion, but that its tissue (or, at all events, certain of its cells) exerts a *catalytic* action on the elements of the blood as it traverses the organ. *In accordance with this view*, Lehmann has afforded us a very satisfactory explanation of the origin of the sugar in the liver. On comparing the composition of the blood of the portal and hepatic veins, he found that the saccharine blood of the hepatic veins contains less fibrin and less hæmatin than the non-saccharine blood which enters the liver by the portal vein. He then proved, by a very logical CHEMICAL PROCESS, that pure crystallized hæmatin *might be resolved into glucose* [grape sugar] *conjugated with a nitrogenous substance*," &c.—*British and Foreign Med. Rev.*, Jan., 1857, p. 32. New York.

Now, it is true that this experiment is against our purpose, excepting in the important fact that it is supposed that blood, in certain conditions, may be chemically transformed into sugar. But how far is the experi-

ment reliable as to the distinction which is made between hepatic and portal blood (§ 1029)? Let us hear Bernard:

"Since the publication of his Leçons, Bernard has been led to give up Lehmann's explanation, and has been driven to the belief, from certain experiments which he has recently made, that *it is not in the blood, but in the* HEPATIC TISSUE *itself, that we must search for the substance which precedes and directly gives origin to the sugar.*"—*British and Foreign Med. Rev., ibid.*

Our interpretation will also readily explain the reason why saccharine matter, or something analogous to it, may be made out of the hepatic blood, or out of the liver, when it has not been produced, or but in a minute quantity, from portal blood. In the one case the requisite conditions are present; in the other they are not. This is obvious enough from the quantity of bile elaborated from the portal blood (§ 417).

Again, this kind of "experimental philosophy" will explain the reason why, according to Vernois, "sugar may be found in the liver of the fœtus and not in that of the mother, and *vice versa*;" and why it is found in the liver particularly after respiring an irritating vapor, which, through the reflex action of the lungs, modifies the whole sanguiferous function, and consequently the condition of the blood. Associated with this there may be something appertaining to the liver which may often enable chemical reagents to effect a transformation analogous to sugar. Again: if such be the philosophy, we should probably find the Chemist often failing to produce sugar from the liver in various conditions of disease. Accordingly we learn from Becquerel and Rodier that "in 140 cases, wherein the nature of the disease was noted by M. Vernois, he only found sugar fifty-six times."—*Ut cit.*, p. 247, 248.

§ 1032, *d.* As the variety of means which have been employed to increase the supposed normal proportion of sugar in the blood, and the artificial production of diabetes, in no respect affect our conclusions, it is unnecessary to speak of them. Our interest lies in the great physiological problems alone, under the direction of the leading facts. But I may say of Bernard's experiment of producing saccharine urine by pricking the floor of the fourth ventricle between the roots of the pneumogastric and auditory nerves, that it is not only an elegant exemplification of the wonderful mysteries of the nervous system in its influences upon organic functions, especially so in connection with the inductive process by which he arrived at the experiment, and should admonish him, profoundly, of the fallacious nature of his chemical and mechanical doctrines of life, but that it demonstrates a direct influence upon the functions of the kidney which places the mechanical hypothesis of "strainage" upon its proper footing. It is in vain to assume that this influence was exerted specifically upon the liver, and that that organ was thus stimulated to an extraordinary production of sugar; for the condition of the kidneys was not affected alone in the elimination of sugar, but in two other and opposite respects, according to the precise place in which the floor of the fourth ventricle was pricked between the origin of the nerves. In one place the urine would be *increased in quantity*, and yielded an abundance of *albumen*; while a little variation of the place of puncture rendered the urine *small in quantity*, and restricted the organic matter to sugar alone. (BERNARD, *Leçons*, &c., p. 339–340.) Moreover, the kidneys and ureters were quite as violently affected by this prick as the capillary circulation of the abdominal organs, while the vessels on the surface of the liver "were more apparent than natural." The whole capillary system of other parts of the

abdomen was thrown into a state of great activity and engorgement, and I shall quote the statement in a note* for the purpose, also, of showing how remarkably the vascular system may be affected by apparently the slightest impressions upon the nervous centres, and variously, too, as the impressions may be a little varied (*ut supra*), and to show, moreover, the absurdity of referring the physical products to the united agency of the nervous power and the chemical forces, and how great the fallacy of expecting to give direction to practical medicine by any analyses of the blood or secretions while they are unceasingly changing in disease through influences propagated by the nervous power (§ 5¼, *e*). Nor will the reflecting mind fail to observe the vast contribution which this experiment makes to the incalculable importance of those by Wilson Philip, as herein recorded, nor how forcibly the experiment confirms the applications which I have made of the English Philosopher's (§ 476–494, &c.).

But again: if it be assumed that the influences were exerted, in the experiment, upon the liver, and that the kidneys merely "strained off" the redundant sugar, how does it happen that no sugar ever appears in the urine during the digestion of food, when, as affirmed by Bernard, it is found throughout the circulating mass of blood? Why never found in the urine in any hepatic affection, and never in any other disease than diabetes? And what shall be inferred of the pathology of diabetes, or of the indications of cure as supplied by Organic Chemistry, when we contemplate the successful treatment, by bloodletting, of the remarkable case recorded in § 1007, *c*?—NOTE Z p. 1130, on *uræmia*.

Since the foregoing was written, information has reached us that later observers have shown, that, whatever may be the influences exerted by the injury of the fourth ventricle, as it respects the hepatic blood, they have no bearing upon the functions of the liver, but of the lungs. From these observations it would result that the special condition of the hepatic blood is owing to some modification of the respiratory function, which is rendered farther probable by the injury being inflicted at the origin of the pneumogastric nerve (§ 461).

1033, *a*. After the remarks in the foregoing section (§ 1032), and upon the hypothesis that it is truly sugar which is discovered in blood by the reagents (tests), or whatever compound it may be, it must be conceded in behalf of the hypothesis, that the same apparent result is brought about by different modes of proximate analysis. But even this coincidence neither establishes the certainty that the products consist of sugar, nor render it unquestionable whether any two of them are alike. (§ 54, *a*, *b*.) It is but a *guess*, liable to the doubts which are so forcibly expressed by Professor Lehmann in sections 1029, 1030. Nevertheless, in a physiological sense, it is the most involved and important inquiry which Organic Chemistry has yet presented, and hence the space which is here allotted to it. Should this persevering Offspring of the inorganic world succeed, in connection with experiments upon living nature, in establishing the supposed double function of the liver, it will have contributed a large service to Physiology. But such are the complete contradistinc-

* "Quand, après avoir piqué chez un Chien ou chez un Lapin l'origine des pneumogastriques, nous lui avons ouvert la ventre au moment où la surexcitation portée sur la foie presentait son summum d'intensité, nous avons vu qu'alors il y avait une plus grande activité de la circulation abdominale, le système capillaire était gorgé de sang, et les vaisseaux de la surface du foie plus apparents qu'à l'état normal. Les reins sont alors eux-mêmes très surexcités, les uretères sont très irritables; il suffit de la toucher avec la pointe d'un bistouri pour les voir se contracter energiquement."—BERNARD, *Leçons*, &c., p. 331. 1854–55.—See BUDGE's Exp. § 494 *e*, and § 635.

tions between organic and inorganic beings, that it may be safely concluded that it can go no farther than to distinguish the difference between the physical constitution of one substance and another. Here it ends, and here the vitalist takes up the result and carries it into the profound labyrinth of organic life. Even so Liebig, § 18 *c*, 42, 53 *c*, 59, 64 *e*, 350, nos. 59, 79. (Also, § 5, 6, 53 *b*, 222 *b*, 351, 362, 376½, 409 *j*, 417, &c.)

In the mean time, as an appendage of some moment to the foregoing discussion, and that it may be compared with the extracts from Lehmann's work, in sections 1029, 1030, I shall now state, as an example of searching for sugar, an unsuccessful process observed by Lehmann for detecting its presence in the portal blood of horses:

"The blood, after being neutralized with dilute *acid*, and treated with four times its quantity of water, was coagulated by *heat*, the expressed and filtered fluid was *evaporated*, the residue *extracted with spirit* of 85°, and the spirituous fluid precipitated by an *alcoholic solution of potash*. The portion insoluble in water was mixed with a little water, filtered, treated with dilute *sulphuric acid*, for the purpose of effecting the *metamorphosis* of any *dextrine* that might be present, and THEN EXAMINED FOR SUGAR"!—LEHMANN'S *Physiological Chemistry*, vol. ii., p. 391.

There is also the celebrated test known as Barreswill's solution, which consists of "carbonate of soda (in crystals) 40 parts; bitartrate of potash 50 parts; caustic potash 40 parts; distilled water 400 parts. Make a solution, and add the following: Sulphate of copper 30 parts; water 100 parts. Filter the two solutions when mixed. This solution, when added to a liquid containing glucose, gives a reddish precipitate of reduced copper."

Another chemical test is that of caustic potash, "a fragment of which, added to serum containing glucose, gives an albuminous precipitate of a brownish color, due to the combination of albumen with ulmate of potash."

Becquerel and Rodier say, that the chemical processes relied upon are "almost exclusively" the last two—B. and R.'s *Patholog. Chem.*, p. 72, 73. Lehmann commends Trommer's test, which consists mostly of caustic potash and sulphate of copper, but which has been disputed. "But if this test be not admitted," he says, "equal objections may be advanced against all the reagents employed in mineral chemistry; the application of most of them demanding more precaution and skilful manipulation than this test." He thinks well of the polarizing apparatus; says that "Pettenkofer's test is not available for the detection of sugar;" and he would not trust the fermentation-test, nor Maumene's. After mentioning these, and their attendant qualifications, we have the farther discouraging remark, that "all other tests which were formerly employed for the discovery of sugar are open to so many sources of fallacy, as compared with the methods we have already indicated, that we may pass them over in silence."—LEHMANN, *ut cit.*, vol. i., p. 251, 256.

1033, *b*. Now, all the foregoing (§ 1033, *a*) would be commendable, did it end, so far as Chemistry is concerned, with the experiments themselves; although, as we have seen (§ 1029, 1030), it can rarely supply any reliable ground for induction. But it is an example only of a vast amount of experimental Chemistry which has been carried far into the labyrinth not only of the physiological but morbid states of the body, and commended to Physicians under the illusory name of "experimental medicine."

But, suppose it to be all true, there never was and never will be a physician who will or can apply it in practice, very few who can understand it, no one qualified for the analyses, no time, in acute diseases at least, for inquiries so difficult and tedious, and no one who will fall into the absurdity of applying to a competent Chemist, if he can find one, to search for disease in morbid changes of the blood, or secretions, not even of the urine. In chronic affections, a few simple observations upon the latter, and which are alone reliable, will sometimes inform the physician of the presence of some unusual substances as the products of disease; but this knowledge can never aid him much in the treatment of the malady (§ 427). Take the strongest of all examples, diabetes mellitus; a knowledge of the existence of sugar in the urine has neither contributed to a knowledge of the pathology of the disease, nor given the slightest direction to an enlightened practice. An exclusively animal diet has not reached the pathological condition, and the sugar has gone on as usual whatever the food consumed. Nor is it any better with the "urea-diathesis," or with "albuminous urine," whether the latter respect the kidneys or dropsical conditions; but, on the contrary, it has led to many blunders between the presence of disease and the ingesta, or between one disease or another (§ 426, 427, 639, 673, 675, 679, 686 *d*). If the Physician rely upon these superficial and uncertain, or imaginary signs, if he have not the sagacity to discover the nature of disease through the ready and intelligible signs supplied by Nature, or cannot avail himself of experimental observations upon the effects of remedies which have been accumulating for ages, or be incapable of applying in practice the principles which have been founded upon these observations in their connection with other intelligible principles in physiology and pathology, his case is as hopeless as must be that of his patients (§ $5\frac{1}{4}$, *f*). And yet, it is a remarkable fact, that many medical Authors, who take the "experimental medicine" of the day upon trust, are vastly more certain of the accuracy of the experiments, and of their application to the healing art (and yet without applying them), than the very able men who have been employed long and assiduously in the inquiry. (§ 1065, *b*, *c*.)

It was but very recently that the Medical Profession in Europe and America calculated upon Morbid Anatomy as a grand basis for medicine, and the present writer took a long ground against it. And where is it now? Dissipated by Liebig as by an enchanter's wand. Where now is the so late "Numerical Method?" (§ 1006, *a*.) Swallowed up by the Laboratory. Where, the Humoral Pathology, which Andral reproduced and ingrafted upon Vital Solidism? (§ 819, &c.) Ingrafted upon Chemistry. Where the so late "experimental philosophy" which aimed at the causes and cure of human maladies by the introduction of poisons and remedial agents into the circulation of animals? (744.) "Given place to an 'experimental philosophy' in which organic life has no participation" (§ $5\frac{1}{2}$ *a*). Where the "division of labor" in the fragmentary system of "specialities?" Concentrated in the hands of Organic Chemistry (§ 960, *c*). Where, I ask, are the memories even of those so recent as Hunter and Bichat? All buried in the common Cemetery. Where, in brief, is Organic Life? Echo answers, extinguished by the Laboratory (§ 695–709. See, also, the Author's Essays on *Morbid Anatomy*, and on *the writings of M. Louis*, in Medical and Physiological Commentaries).

§ 1034. Finally, in the discussion of controverted questions between

the Physiologist, as he looks upon animated nature in its healthy and morbid aspects, and the Chemist, who is, or should be, concerned alone with dead matter, it is sometimes difficult to maintain a perfect moderation of style when the Laboratory becomes dogmatic, and especially when exclusive (§ 1, *b*, 350, *Mottoes*). And I may be now permitted to at least correct a misapprehension of Professor Lehmann's, who, in the seclusion of the Laboratory, like all others of the same laborious and abstract pursuits, is evidently uninformed of the doctrines of the vital Physiologist, or does him an injustice which I should be unwilling to surmise. I allude to the following paragraphs, although there is much more of the same nature:

"We have not hesitated to avow that we have assumed a *thoroughly radical* point of view in reference to specific vital phenomena and vital forces; for we cannot rest satisfied with the *mysterious obscurity in which they have* been artificially enveloped."

Our Author then proceeds to designate the Science of Life as a system of "*metaphysicology*," and to confound Physiologists with the "*advocates of a romantic poetry of nature;*" though, it is true, he had the encouraging success of Liebig before him (§ 350, *Mottoes*). Thus, our Author:

"It would be well if *these spiritualists* would look down from the high stand they have chosen, and deign to believe that there are some among those experimentalists, who, *clinging to matter*, and gathering their facts with ant-like industry from the lowly earth, notwithstanding that they have long held communion with the poet-philosopher, Plato, and the philosophical natural inquirer, Aristotle, and have some familiarity with the Paraphrases of Hegel and Schelling, are yet unwilling to relinquish their less elevated position. If these happy admirers of their own Ideal had descended from their airy heights, and closely examined organic and inorganic matter, they would not have deemed it necessary to assume, that, besides carbon, hydrogen, nitrogen, and oxygen, organic substances must also contain an *organagenium*, or latent *vital force*, or whatever else they may be pleased to call it. Had they sought information from a *Chemist*, they would have learned that, when exposed to the clear light of rigid logic, THERE IS NO ESSENTIAL DIFFERENCE BETWEEN ORGANIC AND INORGANIC BODIES. A Chemist, totally unacquainted with organic matter, would *à priori* have deduced all these *incidental differences* of matter from the doctrine of affinity and the science of stoichiometry, evolved from *dead matter*. (§ 1052.) However these advocates of a romantic poetry of nature may despise the swarm of industrious investigators, who are often unwearingly occupied for years together in endeavoring to collect a few firm supports for the great edifice of a true philosophy of nature, we do not despair of seeing our work rise in simple grandeur, more durable and lasting than these sophisms of natural philosophy, which, passing through ages, from Pythagoras and Empedocles to Schelling and Hegel, have, like the sand of the ocean shore, been alternately upborne by one wave and ingulfed by the next."—LEHMANN'S *Physiological Chemistry*, vol. i., p. 33, 34.—See p. 157, § 350, *mottoes h–l.*

That this is not a hasty rhapsody appears from a *note*, in which our Author states that he had "expressed similar ideas in an Article which appeared in the 'Gegenwart.'" At another time, also, he caricatures the doctrine of vital solidism as "a belief in *supernatural* forces of matter."—*Ibid.*, vol. ii., p. 380.

There is no doubt that our amiable Author (whom no one is disposed to disturb in his legitimate pursuit) is very correct as an expositor of the objects and opinions of Organic Chemists when he asserts their belief that "*there is no essential difference between organic and inorganic* bodies;" as, indeed, appears abundantly in these Institutes. It is, therefore, all a foregone conclusion with the Chemist, before he approaches the living being with acids, and alkalies, and metallic oxides, and retorts, and crucibles, that he will quickly "deduce all the incidental differences of matter (animate and inanimate) from the doctrines of the Laboratory as evolved from dead matter." Hence, it is evident, besides his affirmation, that our Author has deduced all his knowledge of Haller, Baglivi, Hunter, Bichat, Müller, C. Bell, M. Hall, Tiedemann, and other illustrious Physiologists of recent times, from what he has gathered from "the Poet-Philosopher, Plato, and the philosophical natural inquirer, Aristotle, along with the Paraphrases of Hegel and Schelling;" glancing, it is true, at their kindred, Pythagoras and Empedocles, but skipping over, even, such ultra "Spiritualists" as Hippocrates, Celsus, Galen, Aretæus, Avicenna, &c., from whose works he might have "deduced *à priori* all the incidental differences" between them and their modern Antitypes. (§ 4½, 5–6, 189, 292, 334, 350¼, 350¾ *g*, 351, 360–364, 366, 376½, 376¾ *b*, **744, 1006** *a*, **1029, 1030, 1075** *b*.)

Nevertheless, although our Author "cannot rest satisfied with the mysterious obscurity in which the vital phenomena have been artificially enveloped," and, although "a Chemist, *totally unacquainted* with organic matter, would *à priori* have deduced all these incidental differences of matter from the doctrine of affinity and stoichiometry *evolved from dead matter*," he is coerced, not unfrequently, to contradict himself (§ 626, *b*), and to admit, as in the following example, that the "incidental differences" relative to absorption alone have been altogether beyond any explanation in physics, which is apparently a very simple phenomenon compared with many other processes of life, even as it occurs in plants (§ 1053). Thus, our author:

"If, however, we still *continuously* encounter a number of phenomena in the *living* body, which seem to be at variance with the endosmotic laws with which we are at present acquainted, and if many interesting experiments, as, for instance, those of Böcker, still appear to *defy explanation* by simple molecular action, this merely proves that we are *still deficient* in the physical knowledge necessary for the comprehension, *in a physical sense*, of the *casual* [!] connection of such phenomena." (See § 1052.) "We may, however, conclude, from the *scanty* facts before us, that the movements of soluble matter within the living organism, and more especially the phenomena of absorption, *must be supposed* to depend upon certain physical laws."—LEHMANN'S *Physiological Chemistry*, vol. ii., p. 376–399.—Also § 176 *d*.

And again, our Author, still forgetting himself, is at considerable pains in showing that "if zoo-chemistry ever fulfil its object, it must be by the joint aid of Chemistry and *Physiology*."—*Ibid.*, vol. i., p. 24. But how far our Author (and Liebig, who is of the same opinion) is qualified to reason upon the profound problems of life will sufficiently appear from the following jumble:

"Weariness of the senses is the diminished impressibility of the nerves of sense, but its cause cannot reasonably be sought for in any other than a CHEMICAL CHANGE, experienced by the conducting substance of the

nerves. Such a chemical metamorphosis of the nerves of sense from external impressions can no longer greatly excite our astonishment, *since* we have witnessed the *unexpected* phenomenon of a picture produced suddenly, and as it were by magic, from the chemical changes effected by the rays of light *on an iodized silver plate* [!] Should we not be equally justified in saying that the iodized plate, which, after being exposed for a few seconds to a strong light, gives *only faint* and half-effaced images, IS WEARIED LIKE THE RETINA, when, after repeated and continuous perception of an image, it gives back only the faint outlines of the object?" !! —*Ibid.*, vol. i., p. 30. (Also § 349 *e*, 350½ *n*, *p*, 350⅔ *e*, *f*, 350¾ *e*.)

But this is only an example of a vast amount of a corresponding nature by which I have endeavoured to show that Chemistry and Physiology are profoundly distinct from each other, and that when the Chemist departs from his legitimate pursuit to gather laurels in Medical Science, whatever may be his ability, he is acting the part of a mere Charlatan (§ 376½, 626 *b*).

Our Author takes it hard that Chemical Philosophers should meet with any opposition in their invasions upon Physiology and practical Medicine, notwithstanding his own declaration that they are not to be trusted in their organic inquiries (§ 1029, 1030). But since he indulges the illusion that none but the most imaginative have raised an obstacle to the ambitious career of Organic Chemistry, it is not quite apparent why our Author's self-complacency should have been so much disturbed as seems to be implied in the concluding part of a foregoing quotation (page 796). The capital error of our friends is forcibly presented in that extract—"Who are often *unwearingly occupied for years together* in endeavouring to collect a few firm supports for the great edifice of a true philosophy of nature," and which has been often the subject of comment by eminent Philosophers, as may be seen at pages 157, 173, § 350, *Mottoes, h, i, k, l,* and No. 97 of parallel columns.

Our Author's error, therefore, as will be readily seen, proceeds from an unceasing devotion to the phenomena of dead matter (§ 376½), which, as a consequence, leads to a total disregard of all the facts which have been accumulated by the students of living nature, and an obliviousness to the grand consideration that even such students can have no just appreciation of the natural processes of animated beings unless also well skilled in Pathology and Therapeutics (§ 5¼ *e*, *f*, 5½ *a*, 6, 53 *c*, 129, 134, 137 *d*, 151, 163, 165 *b*, 167, 191, 234–235, 237, 285, 303⅔, 376½, 376¾, 447 *a*, *b*, *c*, 516 *d*, No. 6, 676 *b*, 801 *a*, 819, 1006 *a*, 1029, 1030, 198, 640, 1060).

But our Author has now the consolation of knowing that he has achieved his object of convincing a multitude of Physicians (§ 5½, *a*) that they are worthy of his rebuke, and that the true philosophy of medicine can be acquired only through an implicit dependence upon the Laboratory of the Organic Chemist (§ 376½). Nevertheless, our Author is too shrewd a politician not to have observed the action which has been setting in against a pursuit in which the Physiologist and Physician have had no participation whatever; nor is he less aware of the causes. Lest the monopoly, therefore, should be lost, he deals a few blows upon the most submissive part of the Profession in this wise:

"Enthusiasm," he says, "in the cause of Organic Chemistry has degenerated among many Physiologists and Physicians into a *fanaticism*, which, even in the best cause, tends to invalidate a host of truths in its

endeavours to uphold a single fact (§ 5½ *a*, 530).—LEHMANN, *ibid.*, vol. i., p. 1.

But, then, how will our Author compromise the trouble with this class of "Physiologists and Physicians," if "there is no essential difference between organic and inorganic bodies," or, especially, if "a Chemist, totally unacquainted with organic matter, would *à priori* deduce all the incidental differences from the doctrine of affinity and the science of stoichiometry, *evolved from dead matter?*" Our Author's entire work proceeds upon these premises, along with a profusion of ridicule upon the physiological doctrines of life and disease, of whose deductions from the phenomena of living nature, through a long course of ages, he is as profoundly ignorant (as he virtually admits) as he is able and accomplished in that mere physical department of science to which he has devoted his thoughts and his labors. Our Author, therefore, seeing the "handwriting upon the wall," as appears in preceding quotations (§ 1029, 1030), ventures the future upon denunciations of those whose peculiar province it is to unfold the Science which Nature has isolated from all others in its fundamental laws. But I ask our Author and others who have not been less vehement in unmannerly malediction upon all Medical Philosophers of the past, whether the phrensy of a morbid ambition is not most likely to react upon themselves? (§ 6, 376½.) And I put it, also, to Physicians, whether they will continue to follow the wake of Organic Chemistry, or assume the independence of thinking and acting for themselves? And here I shall take the liberty of repeating a passage from the Commentaries which covers a greater range of the fictions that have been substituted, in recent times, for philosophical medicine. The Author was referring, specifically, to M. Louis's attempt to prepare the way for his anatomical and numerical methods by proclaiming that "*Medicine is now in its infancy;*" while it is but just to the French Philosopher to say, that the German is more dogmatically abusive, in various parts of his work, of every Physiologist and Physician who has admitted "a vital force or whatever they may call it" (in our Author's language), from Hippocrates to the present day. The *Commentaries* thus:

"That the World should have passively acquiesced in this unreserved obliteration of all its medical knowledge and principles (executed, too, in no very gracious manner), was neither just to itself, nor watchful of its dignity. That it should have received the ostracism with a commendation proportioned to its abruptness and insensibility must remain forever the most extraordinary record of all human affairs; and, when after ages shall look back upon the present, groping its way in a midnight darkness of its own creation, and rejoicing, as it were, with the prattling "infancy" of a once noble and stupendous science, and witness, as its results, the experimental processes by which the new being was to be carried forward to maturity—the myriads of victims who furnished their quota to the morbid anatomist—the attempts at converting morbid into healthy blood by chemical agencies, first in a 'porringer,' and then, by analogy, up to the living organism—the conflict between the remaining disciples of Nature and the abuses of the Laboratory—the almost universal substitution of the forces of physics for those specific powers which had hitherto rendered Physiology and Medicine intelligible and consistent sciences, besides a multitude of other strange devices, contributed and cordially received from all manner of workmen, as choice materials for the new foundation—when, we say, after ages shall look back

upon this dark spot on the brightest escutcheon of the world, it must be regarded without sympathy, and as an act of voluntary humiliation (§ 376½, 530, 819 *b*).—Medical and Physiological Commentaries, vol. ii., p. 684. 1840.

§ 1035. Although the foregoing review of Physiological and Pathological Chemistry may be unimportant to all but the present writer, he will, nevertheless, say, that personal considerations had nearly deterred him from making them. In all his writings he had regarded his position as so isolated, that he had not anticipated much sympathy and less encouragement, and he has, therefore, been agreeably disappointed in finding numerous and very able advocates, and by many unexpected and very distinguished honors that have been conferred upon him by the most renowned Medical Societies in Europe. These marks of recognition, he hopes of approval, have always awakened the most profound gratitude. But the more he has prosecuted his studies, the more impossible has he found it to modify his opinions on Medical Philosophy, and the more desirous has he become of submitting this enlarged experience to the judgment of mankind; and, although he is not unmindful that perfect independence is conceded to the Cultivators of science, yet he is most anxious to be just to those whose writings have proved to him a fountain of knowledge, and whose kindnesses have awakened the deepest sensibility. And, while thus employed in this very personal manner, he will not forego the gratification of uniting to that of the medical world his own admiration of the labors of Becquerel and Rodier, and particularly of those researches which are presented in their work on "Pathological Chemistry in its application to the Practice of Medicine." The very flattering dedication to himself which occurs in the London edition of that work might, in connection with the considerations just stated, have prompted him to have still maintained the silence (unimportant to be sure) which he has for some time observed, did he not find in the work so great an amount of enlightened research, and which he can heartily commend to the American Medical Profession. It is, indeed, rather a system of practical medicine than what the Title imports. Its authors have been attentive *observers of disease*, and their valuable experience is presented in its direct relation to Pathology and Therapeutics. Their pathological chemistry of the blood is, also, but little liable to the objections so forcibly stated by Professor Lehmann (§ 1029), since it often extends but little beyond the specific gravity, and the proportions of water, globules, albumen, fibrin, and fatty and extractive matters, in different forms of disease, and their comparison with a normal standard. And, although these analyses advance our knowledge of pathological conditions, the present writer cannot but adhere to his opinion that the treatment of disease must turn essentially upon the import of symptoms and of remote causes, in connection with the principles which have been deduced from the phenomena of healthy and morbid actions, and from the results of hygienic and therapeutical treatment (§ 413–463, 639–709); nor has he any doubt that his Authors think so too. They belong to the school of Vitalists, ever designating the blood as the *vital fluid*, and quote, approvingly, from Simon's Animal Chemistry, the following enlightened opinion respecting *fibrin*, which stretches far into other great problems in vital physiology. Although stated as an abstract fact, it associates with itself the whole labyrinth of physiological results, and is unapproachable by chemical laws. Thus:

"The fibrin, in its normal physiological condition, is the result of the transformation of a certain amount of the globules. This transformation, which is of a *vital nature*, is due to the action of the oxygen of the atmosphere on the one hand, and, on the other, to the *numerous reactions* which take place during the passage of the blood through the different tissues and organs of the body. The globules, before being assimilated to these tissues, and thus contributing to interstitial nutrition, pass through a transition state, which is the fibrin (§ 42)."—BECQUEREL AND RODIER'S *Pathological Chemistry*, p. 105.

However much the writer may differ from the chemical school of medicine, his attention has been directed to their researches during the greater part of his professional life, and, he acknowledges, with intense interest and never-failing information, while he also commends to his medical class the same habits of inquiry. He had known nothing of the composition of organic nature, nothing of those elementary combinations which so forcibly distinguish it from the inorganic kingdom, and many other relative details, nor could these Institutes have been written, without the revelations afforded by Chemistry (§ 376$\frac{3}{4}$, *b*).

PROGRESS OF PHYSIOLOGY.

STRUCTURE OF ORGANS.

1036. Many interesting disclosures have been recently made in the minute anatomy of some of the complex organs, and the microscope has been brought to bear advantageously upon the subject in connection with improved methods of minute injection. The structure of the kidney, whose rank in organic life I have advocated in foregoing sections (§ 417, 422–427, 892$\frac{3}{4}$ *a–c*, 1032), has been subjected to much critical inquiry, and although the exposition of its elaborate organization call up an association with the most complex mechanism of art, it reminds us as little of "a strainer" as it does of a musical instrument (§ 1032). But the most curious and intensely interesting discovery relative to this organ is Brown-Séquard's development of a startling function appertaining to the renal capsules, and which should silence forever all attempts to "deduce the incidental differences between organic and inorganic bodies from the principles evolved from dead matter" (§ 1034, *Lehmann*).

The anatomical details of the nervous system, especially of the spinal cord, have been also ably investigated by Lenhossék, Van Der Kolk, Brown-Séquard, and others, and impart a great interest to the study of the organic life of animals. All this, and much more of a corresponding nature, opens very widely the wonderful mechanism of organic beings, develops more forcibly that incomprehensible variety of Omniscient Design which is apparently excluded from the mechanical constitution of inorganic bodies, and thus, and in other ways, aids in placing the chemical and physical doctrines of life and disease upon their proper level. (See *Index*, article DESIGN.)

Nevertheless, it must be conceded that this knowledge does not indicate the functions of organs, or their modus operandi, or the physiological laws which they obey, nor ever will. It simply enables us to trace out the channels through which the properties of life carry on their stupendous work (§ 130, 131; *Bichat*, *Liebig*, *Milton*). As it affects, therefore, in no other respect the facts and the doctrines set forth in this work than to give them confirmation, I shall not advert specifically to the dis-

coveries in this branch of Physiology (§ 2 *c*, 83, 131, 133 *a*, 136, 699–708).

THE NERVOUS SYSTEM. SYMPATHY.

1037, *a*. There is, however, one discovery relative to the nervous system, which, although it do not disturb in the least any law or proposition laid down in these Institutes, but goes to confirm the whole, and, withal, corrects a partial error in the supposed functions of a portion of the spinal cord, I shall now state in a summary manner. I need not say that this interesting disclosure comes to us from Dr. Brown-Séquard, whose genius and industry have also enlightened the physiological world upon special influences of the nervous system, which, if not as important in their relations to the laws of that system, are more attractive. Among these may be mentioned his remarkable experiment of producing epileptiform convulsions, through a special association of the nervous influence with a particular point in the skin by sections of the spinal cord, and an extension of the researches begun by Petit, Magendie, and Flourens, upon turning and rolling, developing, apparently, as in the auditory nerve, centres of nervous influence in the nerves themselves; which appeared in a collation of his writings, entitled "*Experimental Researches applied to Physiology and Pathology*, p. 18, 36, 80, 84, 99; 1853.

These experiments, therefore, like Bernard's, of pricking the medulla oblongata (§ 1032, *d*), not only possess a refreshing novelty, but constitute new and forcible methods of demonstrating the influence of the nervous power upon organic actions and muscular motion, and of illustrating the laws of sympathy; while, also, they contribute a welcome part in rescuing Physiology from Organic Chemistry (222–235, 452–530, 635, 893 *a*, *c*, 902, 905 *a*, 924).

§ 1037, *b*. Brown-Séquard's discovery relative to the spinal cord modifies the statement made in the brief sections 465, 468, at pages 290, 291, so far as the experiments show that a division of the posterior roots of the spinal nerves does not destroy sensation, and which are conductors only to the central gray matter. It would have been sufficient, therefore, to have stated this fact (in itself unimportant to these Institutes), did not the experiments reflect, in other respects, a great amount of light upon our doctrines of remote sympathy, and place them upon a clear and intelligible ground. They present, also, an admirable analysis, as I apprehend, of the anatomical media of *common* and *specific* sensibility (§ 188 *b*, 197–199, 450), and that element of remote sympathy which I have designated as *sympathetic sensibility*, and which belongs especially to the organic life of animals (§ 197, 201–204, 451 *d*, 903). The conclusions at which Dr. Brown-Séquard arrived are summarily and well expressed by a Reviewer as follows:

"1. The idea that the sensitive impressions are conducted to the encephalon along the posterior columns is entirely erroneous. 2. The gray matter of the spinal cord, although itself deprived of sensibility, is an organ of transmission of the sensitive impressions. 3. There are two kinds of sensitive fibres in the posterior columns of the spinal cord, some going up towards the encephalon (centripetal or ascending fibres), some going in the opposite direction (centrifugal or descending fibres). 4. There are also ascending and descending fibres in the posterior gray horns, and very likely in the posterior parts of the lateral columns. 5. These ascending and descending fibres in the posterior columns come mostly, if

not entirely, from the posterior roots of the spinal nerves. 6. The posterior roots send also fibres to the posterior gray horns, and very likely to the posterior parts of the lateral columns. 7. All these fibres soon leave the posterior columns, the posterior gray horns, &c., in order to go into the central gray matter. 8. All these sensitive fibres decussate very near to their entrance into the spinal marrow from the posterior roots. 9. There are some transverse fibres in the spinal cord, coming from the posterior roots, which do not seem to transmit sensitive impressions. The *motor* nerves remain, after their entrance into the spinal marrow, on the same side, until they reach the lower part of the medulla oblongata, where they decussate."—*Medico-Chirurgical Review*, p. 183, July, 1856.

In his work on "Experimental Researches applied to Physiology and Pathology" (1853), after relating his experiments on the crossed transmission of impressions in the spinal cord, the Author remarks: "I believe I am entitled to conclude, from the facts above stated—1st, that most of the impressions made on one side of the body are transmitted to the sensorium by the opposite side of the spinal cord, so that the impressions on the left side of the body are transmitted by the right side of the spinal cord, and *vice versa;* 2d, that the assumed function of the crossing of fibres in the pons Varolii, and the neighboring parts, does not belong to these fibres, but to the fibres of the spinal cord, all along which they cross each other" (p. 67, 68).

The foregoing, and other experiments, were repeated by Dr. Brown-Séquard in some of the Medical Colleges of this country during the winter of 1856–7, at many of which the present writer was so fortunate as to be a spectator.—NOTE AA p. 1131.

§ 1038. The experiments upon the auditory and other nerves (§ 1037, *a*), which (as well as the organization of the nerves, particularly the auditory) denote special centres of nervous influence in the nerves themselves, concur with other facts in supplying indications through which we may quite readily comprehend the philosophy of *contiguous* sympathy. The plexuses, also, and the ganglia, are thus rendered more palpable media through which, in part, the phenomena are brought about (§ 487 *g*, 497, 499 *a*, 516 *d*, No. 9, 520–523, 524 *d*, No. 4, 893 *a*, *c*).

THE NERVOUS POWER. ORGANIC PROPERTIES.

§ 1039. Moreover, we are indebted to Brown-Séquard for a multitude of experiments illustrative of the laws of *reflex action*, as applied by myself to pathology and therapeutics (see *references* p. 912), and variously establishing the laws of the vital functions as set forth in these Institutes (§ 462–494, &c.). The experiments enforce the distinction between the nervous power and the properties of organic life (§ 167, 168, 170 *a*, 172, 175 *a*, *b*, 176–178), assure us that the former acts only as a stimulus, or other modifying cause, to the organic properties, variously modifying organic actions, and developing muscular motion, voluntary or involuntary, through its operation upon the essential properties of life that are inherent in all parts, profoundly concerned, as a modifying agent, in the processes of disease (§ 222–240), and fulfilling the great laws of sympathy (§ 452–534). Some of these results are remarkably open to observation; such as the influence of the nervous power upon the small bloodvessels, and vessels of secretion, whether by irritating or dividing a nerve. That by our Author, of paralyzing arteries by the division of nerves, confirms the similar ones by Buniva and others

(§ 399, 485), and, with analogous observations, establishes the doctrine inculcated in these Institutes upon the main ground of the phenomena of life, that the whole Capillary System possesses the power of an active dilatation and contraction (§ 384–387, 392 *a*, *d*, 393–399, 410, 411, 746, 747, 914–920, 929–934, 940, 947, 950, 951, 961, 974, 975, &c.). "My experiments prove," says Brown-Séquard, "that the bloodvessels are contractile, and that the nerves are able to put them in action."—(EXPER. RES., &c., p. 10, *note*.) As an example, Claude Bernard produced dilatation of the bloodvessels of the face by dividing the cervical sympathetic nerve; Brown-Séquard occasioned a contraction of the same vessels by applying galvanism to that nerve, and hence regards the sympathetic as the motor nerve of the bloodvessels of the face.—*Ibid.* This doctrine was advanced by me in 1834, in *Med. Chir. Rev.*—See p .827.

Experiments of the foregoing nature have, indeed, been multiplied by Physiologists to an incalculable extent; but perhaps no one of them has revealed the prodigious influence of the nervous power upon the capillary bloodvessels and the secreting apparatus so impressively, or made such havoc with Chemical Physiology, as Bernard's simple operation of pricking the medulla oblongata (§ 1032, *d*). As the whole of this ground, however, has been gone over extensively in the earlier part of this work, the present reference to the subject is to simply show that the laws and principles herein inculcated have been abundantly confirmed by subsequent researches. Indeed, all these experiments are only equivalent, as it respects the functions of life, to those which were performed by Wilson Philip, and far less with the universal reference that distinguished the corresponding labors of this Philosopher, and without his great physiological objects. But these experiments appear to have been forgotten (p. 290–321, § 462–494, and p. 107, § 224, &c.). Indeed, we see it just now announced that "all these facts [late observations, but analogous to such as abound in these Institutes] establish beyond doubt that the bloodvessels, as well as muscles of animal life, may contract by a reflex action."—(BROWN-SÉQUARD, in *Boston Med. and Surg. Journ.*, July, 1857, p. 477.) This fact alone is evidently fatal to the *catalytic* and every other chemical doctrine of secretion (§ 409 *hh*, *k*, 493 *cc*, 893 *a*).*

WHERE THE NERVOUS POWER EXERTS ITS EFFECTS.

§ 1040. Let us now observe where the Nervous Power exerts its effects. Authors are in the habit of speaking of the Nervous Influence as acting upon organs as a whole, and not upon their minute structure. This is doubtless for the purpose of brevity; and, although in these Institutes the Nervous Power is generally correctly represented as exerting its effects upon the minute organization, as in § 231, 233¾, 245, 395, 410, 447, 456, 483, 487, 516 *a*, 896, 902, 917–924, 940, 946 *b*, 949, 950, 951 *c*, 953, 961, 971–980, 986 *b*, 990½, 999 *c*, &c., I have also frequently employed the collective method. This is calculated to defeat a right apprehension of the action and compass of that power as a vital agent. I am therefore prompted, in this reference to the subject, by the desire of turning the attention of the student to the specific fact, that he may the more readily appreciate the offices of the Nervous Power in its relation to the properties of life in their fulfilment of organic functions, or as they are essentially engaged in the voluntary and involuntary movements of the muscles of animal life.

Whenever, therefore, the Nervous Power is concerned in modifying or

* KRIEMER had long before shown, what Bernard has lately done, the influence of the nerves upon the blood, and applied by me to important principles (§ 485, 952, &c.).

otherwise affecting the actions of organs, its influence is exerted either upon the individual bloodvessels, or upon the minute vessels by which the secreted or excreted products are generated, or upon such other minute parts as may enter into the structure of organs—reaching, therefore, to the vasa vasorum, and as well, in all these respects, to the nervous system itself when the Nervous Power is determined upon it (§ 230, 509, 950); or, when it excites motion in muscles it is by acting upon the individual fibres through their inherent properties.

DISTINCTION BETWEEN THE NERVOUS POWER AND THE ESSENTIAL PROPERTIES OF LIFE.

§ 1041. Many of Brown-Séquard's experiments, as well as Bernard's and other late observers, confirm, also, the distinction which I have endeavoured to show, extensively, between the Nervous Power and the essential Properties of Life, and that the functions, whether organic or voluntary motion, are carried on by the latter, to which the Nervous Power sustains the relation of a vital stimulus. (See INDEX, Articles *Nervous Power*, *Organic Life*, *Vital Properties*, and *Organic Functions*.) Some of these experiments are curious as well as ingenious. As examples:

"I have succeeded," says Brown-Séquard, "in keeping alive, from the 8th of April until the 4th of July, a young cat, about which I have already published a note in Med. Exam., 1852. The palsied parts in this animal had grown in length as much as the sound parts. The growth was such in the palsied limbs that they had acquired more than double the length they had at the time of the operation. The functions of organic life appeared to exist without any disturbance."*

Again, says our Author:

"I lately made an experiment with a view of ascertaining how long a limb, separated from the body of an animal, may be kept alive by means of injected blood. I succeeded in retaining local life in one of the limbs of a rabbit more than 41 hours. The animal was a very vigorous, full-grown one. I killed it by hemorrhage, and, two hours afterward, rigidity had begun in most of the muscles of the two posterior limbs, and only a few bundles of muscular fibres had still a slight irritability. A fine injection of defibrinated blood was then pushed in the femoral artery of the right posterior limb. Fifteen minutes after the beginning of the injection, local life, *i. e.*, irritability, was restored in the limb receiving blood, and cadaveric rigidity had disappeared."—*Experimental Researches, &c., ut cit.*, p. 15, 92. Also, § 109 *b*, 171, 193, 261, 264, 493 *cc*.

Corresponding with these observations are many others in a chapter "*On apparently spontaneous actions of the contractile tissues of the animal body*" (*ibid.*, p. 101–124). In speaking of Spontaneous Movements in limbs of persons who have died of Cholera, our Author remarks, that "Physicians who know how quickly after death the nervous system loses its vital powers will admit easily that these movements *cannot be the result of the action of that system.*" Certainly not, any farther than as the Nervous Power operates as a stimulus to the organic properties, the probability of which, in the cases before us, I have endeavoured to show in § 637. In these cases the Nervous Power is maintained in operation after apparent death by the special influences of the disease. Something like this is seen in the rise of temperature in subjects dead of apoplexy (§ 447, *d*). And this leads me to refer to the common phraseology, "exhaustion of the nervous power," to express conditions of the system which

* In such cases the palsied parts continue to be supplied with the modifying stimulus of the nervous power through the sympathetic nerve (§ 461½, 487 *b*, 483 *c*, 490).

are especially due to its powerful operation (§ 940–952). The expression is evidently without any meaning.

§ 1042. But, as I apprehend, the foregoing phenomenon, in being analogous to the movements of the limbs which take place in decapitated animals, is very different from the contraction of the intestines, the heart, &c., which take place even after the extirpation of the organs (§ 259–265); and I am happy to quote Brown-Séquard as sustaining an important doctrine in these Institutes, that, "contrary to the general opinion, a nervous action is not necessary for these contractions," but that they may be excited by other stimuli (§ 264, 475½, 476½ *c*, 498 *e*).

But the special object of this section is to refer to our Author's experiments upon the *iris*. In 1847 he disclosed the curious fact that light may act as a direct stimulus upon this organ, "so as to produce a contraction of its muscular fibres, manifested by a constriction of the pupil." Very recently, in the London Philosophical Transactions (as quoted in the London Philosophical Magazine), he announces the results of farther experiments, which show that the pupil of an exsected eye contracts and dilates, alternately, according to the degree of light. "I uniformly found," he says, "that the yellow part of the spectrum acted as well as undecomposed light, and that the other parts had either no action at all, or only a very slight one" (§ 188½, *d*). "From these experiments it follows that it is not the chemical or calorific rays, but the illuminating," which produces the phenomenon; that "it is not a chemical action, but that it is by a peculiar dynamical influence that light produces contraction of the iris." "The power of the iris to contract when stimulated by light lasts extremely long, particularly in certain animals. In eels it lasts sixteen days in eyes taken out of the orbit." Muscular fibres, therefore, "may be stimulated without the intervention of nerves. In the iris of the eel the nerve-fibres are found very much altered a few days after the extirpation of the eye, and they are almost destroyed in twelve or fifteen days after extirpation, *i. e.*, at a time when muscular irritability is sometimes still existing."—*London Philosophical Magazine, Supplement*, p. 520; July, 1857.

The foregoing experiments go with a multitude of others in showing that the power by which motion is carried on is implanted in all parts, and that the nervous power is simply a stimulus in developing motion, and, therefore, to a certain extent, on common ground with other stimuli (§ 205–215, 233, 259–265). But they are less remarkable in this respect than some other examples which I have quoted in the *Medical and Physiological Commentaries*, particularly the pulsation of an extirpated heart of a sturgeon after "the auricles had become so dry as to *rustle* when they contracted and dilated" (vol. i., p. 17).*

The interesting fact relative to the iris of an extirpated eye is its obedience to light, while it is not affected by mechanical irritants. We may not conclude, however, from the experiments, that light has any direct action upon the iris in the natural state of the organ. On the contrary, I apprehend that Nature has not adopted any such multiplication of causes, but that she has placed that muscle entirely at the disposal of the nervous influence, and by which the direct action of light upon it is counteracted; nor will it be an easy matter to disprove a conclusion so well sustained by all analogy (§ 500 *l*, 514 *k*, 1072 *a*). Could we, however, reason in this case from analogies supplied by plants, the phenomenon would be readily intelligible. But I apprehend that it is merely an

* This extreme case is related circumstantially in Dunglison's Human Physiology, vol. ii., p. 148, 1836.

incidental result of the organic constitution of the iris in its relation to light as a *remote* exciting cause.*

ANIMAL HEAT IN CONNECTION WITH THE NERVOUS SYSTEM.

§ 1043. Among the contributions to Physiology made by Brown-Séquard few are more interesting than those relative to the production of Animal Heat, and which concur in demonstrating (what is so extensively presented in these Institutes) its dependence upon a purely vital process, and, therefore, independence of any chemical agencies (§ 433–448). Some of these experiments I shall state briefly, and would invite the advocates of the chemical *rationale* to interpret the phenomena through any known analogies in the world of mere matter, if they can; or render the supposed connection between the Nervous Influence and the forces of inorganic bodies in the production of animal heat, or any other result of life, in the slightest respect intelligible. But let us hear our Author.

§ 1044, *a*. In his experiment of dipping a hand in cold water two facts are farther confirmed through which, in part, I had endeavoured to show that animal heat does not obey the laws of dead matter, and that its production is a vital, not a chemical phenomenon. Thus:

"I have found," says Brown-Séquard, "that the chilling of one hand plunged in water, at the temperature of freezing-point, acted *very strongly* on the temperature of the *other hand*. But, at first, there is no regularity at all in the quantity of degrees of temperature lost by the hand which remains out of the water; and, secondly, we have found once that this hand did not lose any fraction of its temperature. In one case we have observed that the hand kept in the atmosphere did lose 22° F. in seven minutes. The ordinary loss of temperature has been of between 6° to 8° F." But observe that "the greatest diminution of the temperature of the *mouth* has been nearly 1° F., and this only in one case."—(*Exp. Researches*, &c., p. 33.)—NOTE T p. 1125.

Now, in the first place, is seen in the foregoing paragraph a strong exemplification of reflex nervous action in its relation to animal heat, and it is peculiarly valuable to the Vital Physiologist, since it is the same as concerns any other organic product (§ 446, *a*), places the whole on common ground, and as fully pronounced by Bichat, Hunter, and Philip, and as set forth at page 270, § 447, *d*, &c. Secondly, the experiment is not less important in showing that the cooling of the hand in the atmosphere was not at all owing to the general reduction of the heat of the body, and therefore effectually contradicts the law of slow communication of caloric which obtains with dead matter, as applied to animal heat by Edwards, Liebig, Roget, Billing, and others, who cultivate the chemical hypothesis (§ 438 *a–c*, 440 *e*). It is also an exception to our Author's doctrine that "a great many facts prove that the degree of *temperature* and of the *sensibility* of a part is in close relation with the quantity of blood circulating in that part." (*Exp.*, &c., p. 9.) Indeed, our Author remarks, that "Dr. Tholozan and myself have observed that the greater the pain felt, the more the temperature was diminished in the hand left in the air" (p. 34).

§ 1044, *b*. The foregoing experiment was reversed by immersing the hand in water at a temperature of 108° F. But our Author "found no evident deviation of the temperature of remote parts, as the mouth and hand, not immersed in the water."—(*Ibid.*, p. 35.) This experiment

* When *Physostigma*, applied on the eye after death, produces contraction of the iris, it must be through the motor ciliary nerve.—1864.

contributes with the other, by its failure of a sympathetic effect upon the opposite hand, in illustrating the effect of the nervous influence in modifying the calorific function, through the well-known fact that cold is of incomparably greater power, in this respect, than heat; while the analogy supplied by the increase of urine on the contact of cold air with the surface of the body (as related to the sympathetic reduction of temperature in the hand that was not immersed in water, § 1044, *a*), goes to the proof that animal heat is as much a product of vital action as any of the more sensible secretions. But all this is entirely allied to the production of pneumonia, and other inflammations, by a very temporary chilling of the surface of the body, and is mostly interesting to the Physician by its association with these greater phenomena, since it is of no little importance in practical Medicine whether a diminution of animal heat depend upon a mere chemical contingency, or some profound lesion of the organic functions (§ 1057 *g*).—NOTE Aa p. 1131.

From these premises, it appears that when the temperature of the body falls from the application of cold to the surface, or rises from that of heat, the local action induced on the surface, and mostly so the reduction or elevation of its temperature, are of a vital nature, and that the general or constitutional effects are sympathetic, as set forth at p. 246, § 440, *e*, and shown by many direct facts, some of which may be seen at p. 253, § 441, *d*.

§ 1044, *c*. Farther on (*ibid.*, p. 73–77), our Author has a Chapter on Experiments showing the effect of injuries of the nervous system upon animal heat, which concur with the foregoing (§ 1044, *a*, *b*) in their only intelligible import, and bear a general correspondence with those to which reference is made in these Institutes, but which are examined more particularly in the Medical and Physiological Commentaries, in the Essay on Animal Heat. But the modifications of animal heat by morbid influences upon the nervous system, of which our Author has but little to say, are far more important in a physiological, as well as practical, sense, than the experiments (§ 446–447, *d*).

But our Author is far from being alone in the more recent experiments which contribute with the older ones in illustrating the effects of the nervous influence upon the generation of animal heat. Bernard has been largely in this field; and Budge and others have followed up the inquiry. As all these observations, however, correspond with what had been before ascertained, and only go with the earlier to confirm the doctrine about which these Institutes have been interested, their statement would be superfluous.

§ 1045. Séquard has, also, many observations to show the difference of temperature in different parts of the body, which correspond with those of Bichat, Hunter, Davy, and others (p. 270, § 447, *d*, &c.), and which I have employed as another proof that there is no analogy between the laws which regulate the temperature of warm-blooded animals and dead matter; for it had been well determined that every part has not only its own independent heat, but, when not exposed to the contact of the air, the temperature is without change in the several parts respectively, however much it may differ in any two contiguous parts (p. 270, § 447, *d*).

This very palpable proof has hitherto received no attention at the hands of the Chemist; but its accumulation must lead to a recognition of the fact, and not only dispose of the doctrine of free interchange of

heat as resulting from the contiguity of parts, but present an equal obstacle to the chemical hypothesis in the failure of the blood to produce an equilibrium of temperature, as would of necessity be the case were there any applicability to warm-blooded animals of the fundamental laws of an interchange of caloric which obtains in dead matter (§ 440 *e*, No. 14, 1034). Nor has this fact ever been stated as an objection.

FARTHER FACTS RELATIVE TO ANIMAL HEAT FROM THE ARCTIC ZONE.

§ 1046. In treating of the function of *Calorification* (p. 234–279) I have examined, extensively, Liebig's philosophy of Animal Heat, and I have brought up, among other objections, numerous facts which contradict the assumed ratio between the consumption of food and of oxygen gas as the main element of a uniform temperature, and the superadded contingency of clothing as one of the subordinate means; and have followed him into the Arctic regions to inquire into the accuracy of his facts. It is now my purpose to extend this inquiry by consulting the experience of a late Explorer of the North, from which it will be seen that food and clothing are even less important to animal heat than to other products of organic life. This information is obtained from Dr. Kane's late Arctic Explorations, and will be stated in a rather desultory manner. I might, indeed, appeal for similar facts to other explorers who have wintered in the Arctic Regions since this work was published; but Dr. Kane is the latest, most capable, and has supplied ample materials. I shall also dispense with farther comment, which has been fully provided in the earlier pages. But I shall do the work thoroughly in other respects, that this subject may be taken completely out of the hands of Chemistry.

It may be farther premised that Dr. Kane became ice-bound at Rensselaer Bay, in latitude 78° 58′, in September, 1853, where he remained till the spring of 1855, and that the following observations refer to that latitude, or to his more northern *winter* expeditions.

§ 1047. In the first place, Dr. Kane presents a general fact which corresponds with what I have said of *acclimation* and *constitution*, in their relation to organic heat and vital habit (§ 441 *b*–442 *c*, 443 *c*, *d*, 447 *g*, *h*, 535–540, 615–619, 626 *b*, &c.). Thus, our Author:

"The mysterious compensations by which we adapt ourselves to climate are more striking here than in the tropics. In the Polar Zone, the assault is immediate and sudden, and, unlike the insidious fatality of hot climates, produces its results rapidly. It requires hardly a *single winter* to tell who may be the *heat-making* and acclimated man. Peterson, for instance, who had resided for two years at Upernavick (lat. 72° 40′), *seldom enters a room with a fire*. Another of our party, George Riley, with a vigorous constitution, established habits of *free exposure*, and active *cheerful temperament*, has so *inured* himself to the cold, that he sleeps on our sledge-journeys *without a blanket or any other covering than his walking-suit*, while the outside temperature is 30° Fahrenheit below zero (§ 440 *c*, No. 11, 442 *a*, *b*). The half-breeds of the coast rival the Esquimaux in their powers of endurance. The North British Sailors, of the Greenland seal and whale fisheries, I look upon as inferior to none in capacity to resist the Arctic Climate" (§ 1048, *b*).—KANE'S *Arctic Explorations*, vol. i., p. 245.

§ 1048, *a*. We will now come to the subject of Food, which plays so conspicuous a part in the chemical philosophy of Animal Heat (§ 440, *a*,

Nos. 1–8), though there will be something more about clothing (§ 440 *c*, 1047). I may say, however, at once, that Dr. Kane and his party were capable of maintaining their natural temperature with constitutions impaired by disease, and when often nearly destitute of food, fuel, and proper clothing, and with the thermometer ranging for months from 60° to 90° Fahrenheit below the freezing point.

Our Author intimates that he had little faith in *alcohol* "as a fuel for the furnace" (§ 350⅔ *f*, 438 *b*, *c*, 440 *bb*, No. 9, 441 *b*, *c*). He had three laws, only, for the government of his party, the second of which was, "*Abstinence from all spirituous liquors.*" This law was uniformly enforced, and alcohol was "burned" for cooking purposes alone.

During his long detention at Rensselaer Bay the daily journal is mostly made up of a recital of hardships, of which the privation of food, want of fuel, and destitution of clothing, form the most appalling. It is this feature of the Narrative, this incessant struggle for the maintenance of life, which forms its main interest; and the development which is thus afforded of a very extraordinary man constitutes the great merit of the work, and reconciles us to an otherwise fruitless undertaking. The fiction of "Robinson Crusoe" is no match for our Author's realities. He found, it is true, some benevolent sympathy among the Esquimaux, but encountered in the Bears a foe that was equally struggling for life. They devoured the food at the several depots, and it became often exhausted on shipboard.

Under these circumstances winter expeditions were undertaken into still more Northern regions, with the thermometer fluctuating from 40° to 60° Fahrenheit below zero—often 90° below the freezing point. In the first of these enterprises they were cheered on by the depots before them, but soon to suffer the chill of disappointment, and an unsatisfied hunger. Nor did Summer bring them relief; for, in its very midst, only the most scanty supplies of food could be obtained. On the 8th of July, 1854, our Author records in his journal that "we have neither health, fuel, nor provisions." (Vol. i., p. 312.) July 17th, 1854, he writes, "The young ice bore a man this morning. It has a bad look, this man suspecting August ice. It is *horrible*—yes, that is the word—to look forward to another year of disease, and darkness, to be met *without fresh food and without fuel.*" "*Moss* was gathered for eking out our winter fuel; and willow stems and stone-crops, and sorrel, as antiscorbutics, collected and buried in the snow." (Vol. i., p. 343, 348.)

The party entered upon the second winter "a set of scurvy-riddled, broken-down men; our provisions sorely reduced in quantity, and altogether unsuited to our condition;" and the Engraver has added a portrait of the spectacle. (Vol. i., p. 349.)

October 26th, 1854, thermometer 66° Fahrenheit below freezing. January 7th, 1855, thermometer had been ranging since from 70° to 92° Fahrenheit below the freezing point. At this time he also writes, "We require *meat*, and can not get along without it. Our *sick* have finished the *bear's head*, and are now eating the *abscessed liver* of the animal, including some *intestines* that were not given to the dogs. We have now about three days' allowance; thin chops of raw frozen meat, not exceeding four ounces in weight for each man per diem" (§ 440 *bb*, No. 9). A few days later, January 30th, he says, "I gave Wilson one raw meal from the masseter muscle which adhered to another old bear's head *I was keeping for a specimen.*" (Vol. ii., p. 17, 34.)

January 22d, Dr. Kane and Hans went on a dog-journey of 91 miles in pursuit of *meat*, but unsuccessfully. His outfit, in food, consisted of "a roll of frozen meat-biscuit, some frozen lady-fingers of raw hashed fox, and twenty-four pieces of ship-bread." February 4th, "I made," he says, "a dish of *freshened codfish skin* for Brooks and Wilson. They were hungry enough to relish it." February 9th. "Still no supplies. Three of us have been out all day (*night*) without getting a shot. Hans *thinks he saw* a couple of reindeer *at a distance*." "I have not permitted myself to taste more than occasionally *an entrail* of our last half-dozen rabbits." February 10th. "Hans comes in with three rabbits. Distribution: the *blood* to Oleshen and Thomas, and to the other eight of the sick more full rations, consuming a rabbit and a half" (§ 440, *bb*, No. 9). "My journal tells of nothing but sick men, profitless hunts, relieved now and then by the signalized incident of a rabbit killed or a deer seen, and the longed-for advent of the solar light." (Vol. ii., p. 21, 37, 41, 42, 43.)

The party lived on much in the foregoing manner till March 10th, 1855, when one of them returned from a distant Esquimaux hut with some walrus meat. Thermometer now at 72° Fahrenheit below freezing. This meat was soon exhausted. But, March 24th, there had been another windfall, of which he says, "Our ptarmigan gave the most sick a raw ration, and to-day we killed a second pair, which will serve them for to-morrow. I am the only man now who scents the fresh meat without tasting it. I actually long for it, but am obliged to give way to the sick" (§ 440, *bb*, No. 9). Vol. ii., p. 83.

§ 1048, *b*. Again, as to the effect of cold in reducing the heat of man (§ 1047). During the last foregoing period—March 15, "Hans and Myouk returned at eight o'clock last night without game. Their sleep in a snow-drift about twenty miles to the northward, in a temperature 54° Fahrenheit below zero (86° below freezing), was not comfortable, as might be expected. *The marvel is how life sustains itself in such circumstances of cold.* I have myself slept in an ordinary overcoat *without discomfort*, yet without fire, at a temperature of 52° Fahrenheit below zero," or 84° below freezing (§ 440, *c*, No. 11). Vol. ii., p. 69.

Again: "I firmly believe," he says, "that no natural cold as yet known can arrest travel. *The whole story of this winter illustrates it.* I have both sledged and walked 60 and 70 miles over the roughest ice, in repeated journeys, at fifty degrees below zero; and the two parties from the south reached our Brig in the dead of winter, after being exposed to the same horrible cold."—Vol. ii., p. 78.—Also p. 257, § 442 *b*.

Extracts of the foregoing import may be readily multiplied. But I shall only add our Author's remark that "it is a little curious that a short allowance of food does not show itself in hunger. The first symptom is loss of power [not loss of temperature], often so imperceptibly brought on that it becomes evident only by an accident."—Vol. ii., p. 284.

§ 1049. Let us now contrast our Author's unprejudiced experience in TEA with the speculations of Chemistry upon "*alcohol*, *blubber oil*, and *tallow candles*," in their aspect of "fuel," as set forth in former sections (§ 440, *a–bb*, Nos. 7, 9, &c.).

"Under circumstances of *most privation*," says Dr. Kane, "I found no comforter so welcome to the party as our *great restorative*, *Tea*. We drank immoderately of it, and always with advantage." On his remark-

able retreat homewards, they "had been limited for some days to three raw eggs and two breasts of birds a day; but we had a small ration of bread-dust besides; and when we halted, as we regularly did for meals, our fuel allowed us to indulge lavishly in *the great panacea of Arctic travel*—TEA."—Vol. ii., p. 261, 282.

This Tea acted simply as a stimulus to the nervous system, and among its results was an elaboration of heat, just as is explained of alcohol and animal food in § 440 *b*, 441 *c*.

§ 1050. Not a little has been assumed of the voraciousness of the Esquimaux and Samoyedes in proof of the chemical doctrine of animal heat, and there has come to be a settled belief that they would perish with cold unless forever addicted to a gluttonous repast upon walrus and blubber (§ 440, *bb*, No. 9, &c.). Nothing but a visit to their settlements could have deprived Chemistry of this plausible fallacy. This has been effected by Dr. Kane, who found the habits of the Esquimaux near his own winter quarters, in regard to food, precisely the same as those of other savages inhabiting tropical climates. He says of them, that

"However gluttonously they may eat, they evidently bear hunger with as little difficulty as excess," as I have endeavoured to show (§ 441, *c*). And again: "Among the Esquimaux generally, the coldest months of the year, January and February, are often, in fact nearly always, months of privation." (*Ibid.*, vol. i., p. 418; vol. ii., p. 131.) Near our Author's station they were as destitute as his own party.

If we now consult the records which have been carefully made by residents in tropical regions, it will be found that where food is abundant, the savages gorge themselves far more habitually than the wanderers of the polar zone. The following example will dispose of the question before us. Thus, in the "ASIATIC RESEARCHES" there is a description of the Island of *Nicobaras*, in the Bay of Bengal (mean annual temperature 70° F.), by G. Hamilton, in which he says of its inhabitants, that

"They are very fond of sitting at table with Europeans, where they eat every thing that is set before them, and they eat most enormously. They will drink bumpers of *rack* as long as they can see. A great part of their time is spent in feasting and dancing. At their feasts they eat great quantities of *pork*, which is their favourite food. Their hogs are *remarkably fat*, and they eat their pork almost *raw*" (§ 440 *bb*, 441 *c*).—ASIATIC RESEARCHES, vol. ii., p. 382. London, 1799.—NOTE Oo.

"THE PRIMORDIAL CELL."

§ 1051, *a*. The present inquiry refers specifically to what is said at pages 36–49 (§ 63–81) on the development of the germ, and to a universal characteristic distinction between plants and animals, at § 11. The former subject possesses an importance both in a physiological and religious sense, since there are many Philosophers who assume that there is but one primordial cell which serves as a foundation for all organic beings, and that the development of this cell into a plant or an animal, or into a particular plant or a particular animal, is due entirely to the special physical influences that may act upon it, and not at all to any original difference in the structure of the cells or their endowments of life; and this assumption professes to be predicated of the revelations of the microscope; though it is not difficult to understand that the chemical doctrines of life and Lamarck's transmutation of species have had their share in the project (§ 350$\frac{3}{4}$–356). Upon this hypothesis, there-

fore, the only reason why men are not mushrooms is, that in one case the nucleus-cell of a human ovum is subject to physical agents, during its development, different from those which develop a mushroom. Hence it is assumed, that if it were possible to subject the germ of a plant to the agents which unfold the human ovum, it would necessarily grow into an intelligent, responsible being. This purely speculative assumption, which strikes at the whole foundation of organic nature, might be variously argued upon physiological grounds (§ 72–76, 121–123, &c.); but the necessity of this is superseded by continued observations with the microscope, which has been lately correcting its own errors (§ 83, 131), and granting us an opportunity to again believe that the Almighty created the germs of every species of animals and plants with a rudimentary structure and organic endowments as various as the species, so that each one should be developed by special physical agents alone, and the progress of development result in the particular species, and in nothing else, or, at least, in a near approximation, as in the very limited hybrid (§ 190, 1052 *b*).* The microscope, indeed, has ascertained that even a cell is not an indispensable requisite in the germ either of plants or of animals. To this effect I shall now quote a late able writer, who is thoroughly conversant with his subject, and without any hypothesis in view:

§ 1051, *b*. "The general result," he says, "of recent microscopical investigation in regard to the lowest forms of vegetable and animal life, seems to us to lead to this conclusion—that organisms may possess an independent existence, may go through all the phenomena of growth, multiplication, and reproduction, and may even possess considerable power of spontaneous motion [involuntary], without having advanced even so far in the differentiation of their powers as to possess those attributes which are involved in the ordinary idea of a 'cell' (§ 260–265). By way of explaining our meaning, we shall select an illustration from each kingdom; and the comparison of the two will enable us to inquire in what lies the essential difference between them.

"One of the humblest known Protophytes, the *Palmoglœa macrococca*, whose multiplication gives origin to the green slime that is found on damp stones and walls, consists of isolated particles of a spheroidal shape and greenish color, commonly imbedded in a stratum of gelatinous matter, which an ordinary observer would at once pronounce to be vegetable cells. But a careful examination shows that there is here no definite distinction between 'cell-wall' and 'cell-contents;' the whole particle being composed of a nearly homogeneous mass of 'protoplasm,' through which chlorophyll-granules are dispersed." "These particles, increasing in size, undergo duplicative subdivision by the usual process of elongation and constriction; and it is observable that the nucleus gives indications of the commencement of this subdivision earlier than the particle which incloses it. Each new cell, if such it may be called, then begins to secrete from its surface a gelatinous envelope of its own; so that, by its intervention, the two are usually soon separated from one another." "There appears to be no definite limit to this kind of multiplication, and extensive areas may be quickly covered, in circumstances favourable to the nutrition of the plant, by the products of the duplicative subdivision of one primordial cell. This, however, is simply an act of *growth* precisely analogous to the multiplication of cells in the earliest embryonic condition of the higher Plants and Animals, before any differentiation of organs begins to show itself." "Now, for such a mass of protoplasm

* See NOTES PP p. 1142, QQ p. 1145.

to become converted into what is generally regarded as the type of the Vegetable cell, a series of changes must take place in it, involving a differentiation between the cell-wall and the cell-contents; and this involves a greater consolidation of the external layer of the protoplasm, in a more complete liquefaction of its internal portion" (§ 64–65).

"The successive stages of this formation may be best traced out by careful observation of the process of cell-growth in the higher Algæ; but the study of the development of new organs in Phanerogamic plants leads to the same conclusions, and the results at which Mr. Wenham has lately arrived, from observations chiefly made on the newly-imported aquatic weed, *Anacharis alsinastrum*, are so instructive that we shall subjoin a brief summary of them. He finds that when a new leaf is being formed from the main stem, it commences, not as is commonly supposed, in a single cell, but in the *simultaneous development of some hundred at once, which make their appearance in the midst of a mass of protoplasm* which is inclosed in a membrane that subsequently seems to become the epidermis of the leaf. This mass is, at first, *homogeneous;* but it is soon seen to contain a multitude of cavities of irregular size and shape, filled with liquid, while the protoplasm between them becomes more viscid." "These cavities are next observed to be lined with a definite membrane; and within this, protoplasm, chlorophyll, and cyclosis-currents subsequently become indistinguishable."

"Turning now to the Protozoa, we find in the *Amœba*, and in the *Actinophrys*, types of animal existence, which, in so far as we are yet acquainted with them, may be legitimately ranked on the same level as the Palmoglæa, although placed on the other side of the boundary-line. The body of each of these creatures is a minute mass of a substance which long since received from Dujardin the appropriate name of 'sarcode,' and which seems to be the equivalent of the protoplasma of the Protophyta; resembling it very closely in chemical composition and in general attributes, but being endowed in addition with a high degree of contractility. The body is not inclosed, in either of these beings, by a distinct limitary membrane, although the outer stratum of the sarcode obviously possesses more consistence than its inner part, the latter being semifluid. Vacuoles or clear spaces are seen in various parts of the sareode-body; and in these are very commonly observable alimentary particles, introduced in the way to be presently described. Besides these vacuoles, a contractile vesicle, which pulsates at tolerably regular intervals, is always to be distinguished, sometimes in the interior of the body, sometimes near its surface, and sometimes projecting above its surface."

"In these creatures, although they have neither digestive cavity, mouth, nor anus—although they are, to all appearance, *nothing else than particles of animated jelly not even confined within a definite membrane*, the prehension and ingestion of food, the extraction of its nutritive portion by a digestive process, and the rejection of what cannot be thus reduced by an act of defecation, are performed as characteristically, and in reality *as perfectly, as in the highest animals*" (§ 14, *b*).* Continued in § 1052.

* Darwin's late purely speculative work *On the Origin of Species* (*an offset* of the *Vestiges of the Natural History of Creation*, p. 183–188), in which the Author thinks that "in a distant future *light will be thrown on the* origin *of man*"! and whose title reveals its object, may be tried, in part, by the foregoing facts, and especially by those at p. 896–905, 911, 924, 927, regardless of the sheer assumption which forms the essential basis of his work. His difficulty would be as great in assigning his "*one primordial form*" to any other cause than "a Creator" as all its supposed variety of developments. Every relative fact in science, of any importance, contradicts the whole of this violently revolutionary scheme. See Humboldt and Lewis in connection, p. 922, 924.—1860. Also my work on the Soul and Instinctive Principle, edition 1871.

THE GREAT FUNDAMENTAL DISTINCTION BETWEEN ANIMALS AND PLANTS, OR THE BOUNDARY-LINE.

§ 1052, *a* (*Refers to* § 1051). It will now be interesting to the student of Physiology to observe the Universality of Nature's laws in any one of her great departments, in the manner in which she has established a radical distinction between the vegetable and animal kingdoms, and carried out from the lowest to the highest, in both kingdoms respectively, the fundamental plan of rendering one the Producers of organic compounds out of the elements of matter, and the other Consumers of those compounds, and how this characteristic will readily distinguish the lowest species of one kingdom from the lowest of the other (§ 13–14, 18, 173, 185, 298–303; and INDEX, article *Plants*). By this brief recurrence to the subject, which is made for the sake of the following quotation, which brings into view the great economy of life as manifested in the boundary-lines of the Animal and Vegetable kingdoms, and which confirms the principles expressed in this work (in the references to sections just made), we shall refresh our knowledge of the wonderful elaboration of living beings, enlarge our conceptions of the peculiar properties and laws by which they are governed, obtain a renewed evidence of Creative Power, and be quickened in our adoration (§ 409, 493 *a*; and INDEX, articles *Design* and *Creator*).* The foregoing Writer (§ 1051) goes on as follows:

"If we now compare an *Amœba* or an *Actinophrys*, in its quiescent state, with a *Palmoglœa*, or an equally simple Protophyte, we can scarcely assign any structural characters by which one could be differentiated from the other. But when we look at their *physiological* actions, how wide is the distinction. The Protophyte, like the Phanerogamic plant, obtains the materials of its nutrition from the air and water that surround it, and possesses the marvellous power of detaching oxygen, hydrogen, carbon, and nitrogen from their previous binary combinations, and of uniting them into chlorophyll, starch, albumen, and other ternary and quaternary combinations; but the Protozoon, in common with the highest members of the Animal kingdom, is, to all appearance, destitute of any such combining power, and is consequently dependent for its support upon organic substances previously elaborated by other beings; so that it must in the end derive its sustenance, directly or indirectly, from the Vegetable kingdom" (§ 13–14, 17, 303–304). "Again, the Protophyte obtains its nutriment by the absorption of liquid and gaseous molecules which penetrate its body by simple imbibition (§ 289–295, 303 *d*, 303½); while the Protozoon, though destitute of any permanent mouth, stomach, intestine, or anus, extemporizes (so to speak) all these organs for itself whenever there is occasion, ingests solid particles into the interior of its body, and there subjects them to a regular digestive process."

"Thus, then, by attending to the nature of their food, the mode of its introduction, and the character of their respective movements, a line of distinction may be drawn between the Protophyte and the Protozoon, scarcely less definite than that which separates the insect from the plant whose leaves it devours, or the elephant from the tree on whose tender shoots it browses."—*Medico-Chirurgical Review*, p. 3–7, April, 1856; New York edition. The *italics* are generally mine.—NOTE FFF.

And now, will Organic Chemistry pretend that there are only "incidental, casual differences between living and dead matter," and that "there is no essential difference between organic and inorganic bodies,"

* That plants subsist upon *elements*, and animals upon *organic compounds*, is alone fatal to "one primordial cell" (§ 1083, 1085, NOTES, P P, page 1142, Q Q, page 1145).

and that "a Chemist, totally unacquainted with organic matter, would *à priori* have deduced all these incidental differences of matter from the doctrine of affinity and the science of stoichiometry evolved from dead matter"! (§ 1034, *Lehmann.*) Nay more; I ask the Chemist if he will even hazard an assumption as to the "incidental differences" between the fundamental law which enables the Plant to exert "the marvellous power of detaching oxygen, hydrogen, carbon, and nitrogen from their previous binary combinations, and of uniting them into chlorophyll, starch, albumen, and other ternary and quaternary combinations," and that other fundamental law which deprives the Animal "of any such combining power, but renders it dependent for its support upon organic substances previously elaborated by the Vegetable kingdom?" And, before taking leave of our able Chemist, I would respectfully ask him upon what logical ground he can reconcile the doctrine of "simple imbibition" (the "lamp-wick" doctrine, § 289, 291, 350, Nos. 21, 22×65, 23×66, $23\frac{1}{2}\times67$, 68, 69, 70, 25, 26, $26\frac{1}{2}$, 27×71, 72, 73, 74, 75, 76, 77, *parallel columns*) with "the marvellous power possessed by Plants of detaching oxygen, hydrogen, carbon, and nitrogen from their previous binary combinations, and of uniting them into chlorophyll, starch, albumen, and other ternary and quaternary combinations?" (§ 13–18, 37–42, 48, 53, 293–295, 303–304, 360, 409 *c*–411, and the next following sections, 1053, 1054.) It is fatal, also, to the doctrine of unity of cells (§ 1051, *a*).

§ 1052, *b*. And now a word upon the philosophy of hybrid animals. Much has been said in these Institutes upon the *mutability* of the Properties of Life, both as to the transient and permanent nature of their manifestations, and much as to the influence of physical agents according to the nature of these changes. This principle, indeed, lies at the foundation of physiology, pathology, and therapeutics (§ 237–240), is deeply concerned in the temperaments, vital habit, hereditary diseases, and in all philosophical medicine. It pervades the work before us.

When the reader shall have considered the foregoing in connection, let him refer to what is said of the permanent changes which are induced in the ovum by the male parent, and according to the peculiarities of his physical and mental constitution (§ 72–81), and also to the facts attendant on vital habit, acclimation, and the general insusceptibility to a second attack of small-pox, measles, &c. (§ 535–568, 650, 653 *b–d*, 654 *b*, 659, 661, 664–666, 670. Also *Index*, VITAL PROPERTIES).

Now, we may readily discover in the foregoing facts the philosophy which is concerned in the incapacity of hybrid animals to propagate their varieties; and it reflects no little light upon our general philosophy of life, which so readily offers an explanation. This incapacity consists in the simple element that the properties of the hybrid animal have undergone such a mutation, and in strict conformity with the foregoing analogies, that the semen has lost its impregnating virtue and the ovum its susceptibility to the action of semen. Or, if hybrids be sometimes capable of fruitful intercourse for one or two generations, it only shows a correspondence in the ultimate extinction of the procreating faculty, through repeated impressions upon the constitution, with the frequent necessity of repeated vaccinations to extinguish the susceptibility to the farther production of the disease. And so of occasional repetitions of small-pox, measles, and scarlatina, before the susceptibility disappears (§ 654 *b*, 664). The principle is a profound attribute of *life*.

From the foregoing premises it is evident that any general failure of animals to propagate with each other must be regarded as a fundamental test of species. It grows out of a law implanted in the constitution of all organic nature, and a law, as we have seen, of the most comprehensive grasp. For the same reason, therefore, we may conclude that the varieties which may arise from the intermingling of different species cannot propagate themselves beyond a few generations. All this may seem peculiarly Providential. But it denotes a far more stupendous provision, in being an integral part only of one magnificent system of Unity of Design (See *references* in this section as to vital habit &c.).

§ 1052 *c.* It is confidently stated that about nine species of diœcious plants have been known to yield fruit where it was impossible to have had any communication with the male. We shall simply place this conclusion in the category involved in § 1051, *a*. We are not, however, disposed to question the absence of the male plant, but to assume, in that event, the certainty of at least one male blossom or one hermaphrodite having been developed on the stem of the female. That is enough. And, in this conclusion, we are warranted not only by all analogy in both organic kingdoms, but by the specific facts which often occur extensively, as in the conversion of certain varieties of the strawberry (*fragaria*), the "*Hovey*," for example, into exclusively staminate, and therefore unproductive flowers (§ 5¼ *b*, *c*, 74, p. 280, § 449, *d*).

ABSORPTION AND CIRCULATION IN PLANTS.

§ 1053. Although the laws which govern absorption and circulation in Plants have been hitherto variously but incidentally considered in this work, I am disposed to introduce here some more direct observations on account of the immediate bearing of the subject upon absorption and circulation as carried on in animals, and to thus, also, extend the analogy to the philosophy of vegetable heat, indicate the harmony in the laws which govern absorption in Plants, the circulation of sap, and the secreted products of vegetable organization, and the analogy between these and the corresponding phenomena of animals (§ 293–295, 381, 445 *d–g*, *and references* in 1052 *a;* also § 409 *hh*, *k*, 493 *cc*, 893 *a*).

§ 1054. Absorption by the roots of Plants is considered an inadequate explanation of the circulation of Sap among those who advocate the doctrine of capillary attraction. To interpret the process, the leaf, or its equivalent, has been assumed as especially instrumental; serving either as an exhausting apparatus by evaporation, or under the designation of endosmosis, or contributing its aid by supposed chemical influences, through the operation of light, upon the ascending sap. Some one of these hypotheses is considered an indispensable auxiliary to the doctrine of capillary attraction as applicable to the circulation of sap. But, in the mean time, all the remarkable facts as to the elective power of the roots of Plants in their function of Absorption are left to be resolved by "simple imbibition" or the "lamp-wick" doctrine, as it comes to us from Liebig, Carpenter, and others (§ 289–292, 1052, and *references* there. Also § 350, Nos. 26, 26½, 27, 77).

An ingenious application of the Chemical philosophy has been propounded to satisfy the supposed exigencies of capillary attraction not only as it respects the ascent of sap, but as affording the true solution of the downward motion; but it touches not the elective power of the roots. This hypothesis is also thought to be a new obstacle to the doc-

trine which ascribes life to a Plant, and the dependence of its circulation and unique products upon vital actions, and notwithstanding, also, that Plants possess a far greater organizing power than animals (§ 11, 42, 217, 298, 300, 1052); have exactly the same organic functions as animals (§ 249); and generate an endless variety of precise, unique, organic compounds out of a fluid constituted of the same elements as the blood (§ 34–37, 41–48, 136). The hypothesis derives, also, no little importance from its application to the circulation of the blood, and the admission that, if it cannot be sustained in reference to Plants, it must be equally groundless in regard to Animals. The doctrine comes recommended to our attention by its distinguished Advocates.

I have already endeavoured to show the want of all foundation for the more comprehensive principle set forth by Liebig, and of which the foregoing is a *corollary*, that

"*The* CAUSE *of the state of* MOTION *is to be found in a series of changes which the food undergoes in the organism, and these are the results of processes of decomposition, to which either the food itself, or the structures formed from it, or parts of organs, are subjected*" (§ 350, No. 7, *parallel columns*).

This summary principle, in which oxygen gas figures conspicuously, is the combustive doctrine of life. The Projector held it to be applicable to every motion and to all the phenomena of living beings in health and disease (§ 350, Nos. 3, 7, 9, 10, 12, 15, 17½, 21, 73, § 350½), and even in death (§ 350, No. 49, 383). It was laid as the foundation of Therapeutics (§ 350⅔). It was also made to explain our very thoughts and passions; those being also imputed to the union of oxygen with the combustible elements of the brain (§ 349 *e*, 1076 *a*), and which led us to the demonstration upon "THE SOUL AND INSTINCT." It is the circumstance, also, of these fundamental doctrines being still the current Medical Philosophy that has prompted another part of the *Appendix* (§ 433, 1034).

I cheerfully conceded that the foregoing "summary principle, were it true, would be truly beautiful." I therefore felt the importance of showing that it was not only deficient in every necessary element, but was contradicted by all the phenomena of Sympathy, and by all that is known of Pathology and Therapeutics. I am thus provided with a vast series of facts in advance, which must be taken in connection with what I am now to say of the corollary from the fundamental doctrine. This corollary consists in the application of the general doctrine, above, to the circulation of the sap and the blood. It supposes that

The movement of the sap, upward and downward, is generated in the leaf by the action of light in promoting the decomposition of carbonic acid gas, that "*marvellous power* possessed by Plants" (§ 350, Nos. 68, 73, 74, 76, § 1052). The imperfect ascending fluid is thus converted in the leaf into perfect sap, and the change is supposed to institute a propelling force in the imperfect juice, by which the perfected sap is driven out of the leaf and through its downward course. The force, generated in the leaf, is also considered, from the motion which ensues in that part, as the most essential cause of the ascent of the sap, or that the fluid is thus lifted from the roots to the summit of the most lofty trees. Such, then, is the ingenious doctrine which it has been found necessary to substitute for capillary attraction in expounding the circulation of Plants; as the illustration drawn from a "lamp-wick" was found to be applicable only to the radicles in their supposed office of "simple imbibition" (§ 289–293).

This principle has the merit of appearing to be equally applicable to the circulation in animals as to that of plants (§ 350, No. 73, &c.), and it forms a remarkable instance of consistency in a somewhat comprehensive range of a purely factitious hypothesis, though it is regardless of all the overpowering facts which declare its artificial character. The pulmonary circulation is said to depend upon the union of the oxygen of the air with the carbon of the venous blood, in consequence of which this blood drives the decarbonized into the left auricle. But, in the case of the systemic or greater circulation, the order of things is reversed; for here the motion is supposed to be generated by the union of oxygen with the "structures formed out of the food." The same order of events obtains in the liver—all referable to "a series of changes which the food undergoes in the organism," &c. This is Liebig's doctrine of the circulation of the blood and sap, as expressed in the foregoing quotation, and as may be seen farther in § 350, Nos. 3, 5, 6, 8, 9, 10 15, *parallel columns*, and § 383. But the most curious facts about it are, as I formerly said, that it "considers the circulation of the blood due to the agencies of oxygen, and *not at all to the action of the heart*," and that it "is the chemical substitute for the medical aphorism, '*ubi irritatio ibi affluxus*,'" and that it is made the grand basis of all Pathology and Therapeutics (§ 350, No. 10, § 350½–350⅔). The latter, indeed, should naturally flow from the main physiological doctrine, if Nature be truly represented by this (§ 1 *a*, 2 *b*, 383, 447½ *a*, 638, 1089).

Doubtless, this remarkable doctrine of the circulation of the blood might have been left to itself had it not been incorporated in the leading works upon Physiology, as in Dr. Carpenter's, and even carried into popular systems, as by Mrs. Willard, whose appropriation of the philosophy is regarded by Dr. Cartwright (in Boston Medical and Surgical Journal) as singularly ingenious and original (§ 349 *d*, 433).

It is simply my remaining object, however, to inquire into the supposed condition of the circulation in plants, as in all other relative topics concerning man and animals the ground has been sufficiently explored, and since, also, if the hypothesis can be contradicted here, it must equally fail, as is admitted, in respect to animals. I shall also endeavour to avoid a repetition of whatever I may have hitherto said, and limit myself to the statement of a few simple facts.

In the first place, then, it appears to me that the hypothesis contains a fatal element—the prodigious amount of force which is said to be generated in the leaf, as well as in the lungs and other soft structures of animals. On *this point* I am bound to abide by the decision of the Chemists, who say that such *must* be the consequence of the chemical changes which are supposed to be in progress for the production of motion. As expressed by these Philosophers, who designate it as "an *inexpressible force*," or compare it, like Liebig, to a "steam-engine" (§ 350, No. 15), it would be abundantly sufficient for any purposes in artillery or in blasting rocks (§ 392, *c*).

In the next place, there are many other circumstances attending the circulation in Plants, as well as Animals, not hitherto considered, which it would not be easy to interpret by the Chemical doctrine, but which are readily explained by the Vital. Where, for example, is the auxiliary power to capillary attraction (if the latter be included)—where, the leaves, or even buds, when vegetation starts from its hybernating state in northern countries? Observe the *Acer saccharinum*—the remarkable

vigour of its circulation before there is a development of the bud. Indeed, the harvest of maple-sugar often takes place in the Northern States while the earth is covered with snow to the depth of many feet. The circulation, too, is most vigorous after frosty nights succeeded by warm mornings; and when the temperature of the air rises, for a night or two, to some 40° F., the flow of sap is apt to be greatly diminished, but is restored in profusion on the return of frost. What in Chemistry will explain such a phenomenon? And, if it retreat before obstacles of this nature, must it not abandon the whole ground? Nay, how palpable the force of a single fact, when it is considered that the phenomenon is due to the effect of heat as a vital agent on the irritability of vegetable organization, and, singularly enough, as admitted by Liebig (§ 350, No. 65); and whether operating at the higher and more uniform degrees, or alternating at the freezing point, the exact explanation is involved in the law of Vital Habit, as set forth in these Institutes at pages 363–370.

Such, mainly, is also true of the *Vitis vinifera*, which was the subject of many ingenious experiments by the celebrated Dr. Hales, as appeared in his *Vegetable Statics*. And this brings us upon the fashionable ground at which I have been aiming—that of "Experimental Philosophy." These experiments are allowed to have been ably and critically conducted, and are standard references. Let us, therefore, interrogate some of these experiments, and see how far they correspond with Nature, or how far they contradict her and bear out the Chemist; and let us, at the same time, take along the corroborating testimony of other eminent observers, who were obliged to conclude that "the sap moves with such velocity and force, that it must be propelled by vital contractions and dilatations of the vessels" (§ 293). Now, in some of Dr. Hale's experiments there was not only an absence of leaves and buds, but the *stump* alone was the subject of observation. There was wanting, therefore, every thing that could contribute to the fundamental requisite of the Chemist, and, indeed, I may say, what is considered indispensable by all the physical Philosophers to the simple doctrine of capillary attraction as it regards the ascent of sap. . Take, as an example, *Exp.* xxxvi. Thus:

"April 6th, at 9 A.M. I cut off a vine, on a Southern aspect, two feet nine inches from the ground. The remaining stem had no lateral branches. It was seven eighths of an inch in diameter. I fixed on its top the mercurial gauge;" of double curve, to admit the flow of a few inches of sap.

For several days the mercury was more or less pushed up by the sap, according to the state of the weather. "April 14th, at 7 A.M. the mercury rose to 20 inches high. At 9 A.M. 22 inches. Fine warm sunshine. Here we see that the warm morning gives a fresh vigor to the sap." "April 18th (12th day), at 7 A.M. mercury 32 inches high, and would have risen higher if there had been more mercury in the gauge. From this time to May 5th the force gradually decreased [the life of the plant giving way]. On the 18th of April the force of the sap was equal to 36 feet height of water. Here, the force of the rising sap in the morning," the doctor concludes, "*is plainly owing to the energy of the root and stem.*"

In another and similar experiment, at the same time, "the mercurial gauge being fixed *near the bottom* of a vine, the mercury was raised by the force of the sap 38 inches, equal to 43 feet+3 inches+$\frac{1}{3}$ height of

water; which force is near five times greater than the force of the blood in the great crural artery of a horse; seven times greater than the force of the blood in the like artery of a dog; and eight times greater than the blood's force in the same artery of a fallow doe," as ascertained by the rise of the blood in long glass tubes.

In these experiments it is sufficiently manifest that all the physical hypotheses fail, since all of them assume that the leaf, or its equivalent, is indispensable to the progressive rise of the sap. The result, I say, shows, what all organic nature teaches, that so important a function as the circulation, and so exceedingly variable as in plants, yet most exactly suited in every species and every individual (but varied in all the species), to the methodical steps in vegetation, is not dependent upon the capricious operation of any chemical or physical agencies, and that a force is established at the very base of a plant, that shall not fail of the exigencies of vegetable life according to its progressive changes (§ 392 *b*, 394); and the same general principle may be affirmed of every great function of organic life. It follows, therefore, that the sap is moved by something peculiar to living beings, and this is called a vital action. The motion which we have seen, however, would prove utterly destructive to the leaf, and even to all delicate branches, without a gradually countervailing influence upon that action, and the subdivision of vessels will not alone explain the diminution of force. We must hence infer, what is denoted by other important facts, that the reduction of force arises, also, from a modified action in the vessels leading to the twigs and bud, as well as in the bud, or leaf, itself. Here a new action is set up, and a new motion of the sap begins, which is propagated along its downward course by a universal action of the vascular system, modified in different parts according to the special final causes of each part.

Although there were no leaves in the foregoing experiments, and, indeed, only a short stump of the vine, the results were not unexpected to the Philosopher, who adopts the theory that the circulation of sap is owing to temperature. But temperature could not be always made to explain the phenomena, Capillary Attraction was little understood, and Chemistry was yet unfledged. Accordingly, as in all cases where genius departs from Nature, even the acute mind of Dr. Hales has a special hypothesis for each apparent difficulty; sometimes borrowing from the theory of the Vitalist, though less so than most Organic Chemists, and, like the latter, actually raising hypotheses in direct opposition to each other (§ 350, &c.). Take the following examples, where the leaves had obtained their full development, and which will farther show the error of the physical hypotheses. Thus:

"July 4th, at noon, I cut off within three inches of the ground another vine on the South aspect, and fixed to it a tube seven feet high, and filled it with water, which was imbibed by the root, the first day, *at the rate of a foot in an hour*, but the next day much more slowly; yet it was continually sinking, so that at noonday I could not see it so much as stationary"—the life of the stump now giving way.

Here are two important facts. There was no apparent upward force, though there may have been some mingling of the sap with the water; and, secondly, the water being vitally adapted to the plant, it was literally carried down to the roots from the tube at the rate of a foot an hour. There was no chemistry here to effect or in any manner influence the descent; and the water went the wrong way for capillary attrac-

tion. The hypothesis of gravity would be absurd, while it is, also, contradicted by the preceding experiments; and the *descent* of the sap has been a greater problem to our rival friends than its *ascent*. The importance and compass of the proof will be at once perceived. But he, who made the experiment, seeing the want of agreement with the preceding, thought, like a great many other Philosophers, that a conflicting fact would justify a special hypothesis. Let us therefore hear the doctor upon this troublesome point. Thus:

"Now, since the flow of sap ceased at once, as soon as the vine was cut off the stem, the principal cause of its rise must, at the same time, be taken away, viz., *the great perspiration of the leaves.*"

That is the doctrine, along with capillary attraction, of a large section of the physical school; but it supplies no aliment to Chemistry. In all the cases, the blunders arise from a defective observation of facts, and from an ignorance in the difference between the physiological condition of the vine and of other plants before and after leafing (§ 1034). In the experiments first recited, the vine was in its budding season, when vegetable life is in highest activity, and hence the profusion of sap, the force of its circulation, and the development of heat (§ 445, *e*, *f*). On the contrary, in the last experiment Nature had accomplished her greatest of objects in the development of the leaves; and Dr. Hales might have amputated the largest limb, with all the other leaves remaining, and there would have been no bleeding. The same descent of the sap would have occurred, and prompted a different hypothesis.

And now contrast the foregoing experiment with his conclusion as expressed in *Exp.* xxxviii.; the words in *italics* being designed by myself to facilitate the hasty reader. It is a hypothesis, directly opposed to the preceding, for the purpose of expounding another fact:

"The sap," says the doctor, "begins to rise sooner in the morning in cool weather than after hot days; the reason of which may be, because in hot weather much being evaporated, it is not *so soon* supplied by the roots as in cool weather, *when less is evaporated.*" In *Exp.* xlvi. he says, "It was found that the trunk and branches of vines were always in an *imbibing* state, *caused* by the *great perspiration of the leaves, except in the bleeding season*," when there are no leaves. At that season the problem of the stump led him to conclude that "the force of the rising sap is plainly owing to the *energy of the root and stem*" (*Exp.* xxvi.). Will the Chemist explain?

In one of his experiments he attributes an effect to the "sun's warmth," in making the vessels "*dilate and contract a little.*" This is what he means by "the *energy* of the root and stem." Had he adhered to that explanation, and had he a competent knowledge of the physiological laws of vegetable life, he would have had no difficult problems to expound, no conflicting experiments, no contradictions of himself. Few Philosophers, however, as little informed in the philosophy of organic life, have been as accurate in their experiments, or more capable of reasoning upon the facts, than Dr. Hales. But thus it ever is with all who depart from their main field of operations to build up the difficult parts of other sciences. Hales was a divine, and, although adroit in experiments, and better qualified by impartial habits than the Chemist, it is no detraction from his (or their) exalted merits to say, that he knew so little of Physiology he was incapable of applying or even perceiving the facts which the student of organic nature may readily seize and convert to the phi-

losophy of life, and turn against the conclusions of the original observer (p. 923–925, HUMBOLDT).

Am I not, therefore, entitled to conclude, from these few observations alone, that organic beings are contradistinguished from inorganic by what is popularly known as life, or vitality, and with the summary remarks of one of the greatest scientific Botanists of the age, Professor Lindley, of the London University, as expressed in his able analysis of the "First Principles of Botany," that,

1st. "The movement of the sap depends upon a vital irritability, and is independent of mechanical causes" (§ 185, 188, 188½).

2d. "The proximate principles are formed by the vital powers of the plant acting, in conjunction with air and light, upon the fluids contained in its system."

3d. "*All the phenomena connected with the growth of plants are caused by an inherent* VITAL ACTION" (§ 293).

§ 1055. I shall conclude the foregoing subject relative to the circulation in Plants (§ 1054) by a quotation from Liebig's "*Researches on the Chemistry of Food, and the Motion of the Juices in the Animal Body,*" as a farther justification of what I have said of the tampering of Chemists with the philosophy of organic life, in former sections (§ 5, 276½, 676 *b*, 1006 *a*, 1034, &c.), and that it may be compared with § 350, *parallel columns*, and § 350½ *n*. It will be seen that it is nearly the common doctrine relative to the evaporation by leaves in explaining the circulation of sap, as propounded by Dr. Hales (§ 1054). Professor Liebig infers the principle from experiments made upon *dried* membranes! as he had formerly done of the circulation in Plants from the action of "a lamp-wick" (§ 289). Having found the membranes pervious to water, oil, &c., he proceeds to say, in a letter to Professor Horsford, republished in the "*American Journal of Science and Arts*" (May, 1848, p. 415), and which I quote for the brevity of the conclusion, that

"The employment of these results upon the processes in the animal body scarcely requires a more detailed explanation.

"The surface of the body is the membrane from which evaporation goes constantly forward. In consequence of this evaporation, all the fluids of the body, in obedience to atmospheric pressure, experience motion in the direction towards the evaporating surface. This is obviously the *chief cause* of the passage of the nutritious fluids through the walls of the bloodvessels, and *the cause of their distribution through the body.* We know *now* what important function the skin fulfils through evaporation"! (§ 350½, *n–q.*) Our Author did not even think so far as to consider the perpetual vicissitudes of the skin in that respect, nor how wonderfully the blood becomes concentrated in the great internal vessels in the sweating stage of the malignant cholera, or as the same phenomena distinguish a paroxysm of fear. It is also worthy of remark that this distinguished Leader in Physiology here loses sight completely of his universal chemical doctrine of motion, which had been put forth in his "Animal Chemistry" (§ 1054). It forms, therefore, another antagonism for the *Parallel Columns.*

If we may have sometimes appeared deficient in dignified sobriety on similar occasions, we have not thought it necessary to render an apology, but have relied implicitly upon the sympathy of intelligent readers; and while we have not laughed at the able Chemists who have taken upon themselves the labour of persuading Physicians that animals are

only minerals, but rather at the latter, nor have been offended at the arrogance which admits no penetration of the most hidden recesses of Nature but through that veil of ignorance which betrayed the Crispin into the immortal rebuke of Apelles, we have, nevertheless, in our zeal to save something from the wreck, endeavoured to show that all the precepts of the Laboratory justify our application of that rebuke; nor do we feel responsible for any risible consequences.

EXPERIMENTS BY MYSELF TO ASCERTAIN WHETHER THE QUANTITY OF BLOOD CIRCULATING IN THE BRAIN MAY BE REDUCED ARTIFICIALLY.

§ 1056. As the question whether the bloodvessels of the brain may be brought under the influence of bloodletting like those in other parts of the body is intimately connected with the philosophy of the operation of loss of blood, as set forth in these Institutes (§ 941, 950, 975, &c.), and has an important bearing upon the treatment of inflammatory and congestive affections of the brain (§ 971–980, &c.), I shall now introduce some experiments which I made many years ago in reference to the subject before us. Whatever may be thought of the theoretical conclusions, the experiments demonstrate that the brain is on common ground with all other organs as it respects the "influences of bloodletting," and that is the important end at which I am now inviting the attention of the reader; nor am I aware that the experiments have been invalidated. They were communicated to Dr. James Johnson, Editor of the *Medico-Chirurgical Review*, London, in 1834, who published an abstract of the Article in the April Number of the Review for that year, and which was introduced by the following prefatory remarks:

"The Editor having received a long paper from Dr. Paine, of New York, is unable to insert it in the *Med. Chir. Review*, into which no original articles can be admitted, excepting some short cases or pieces of intelligence. The Editor, however, has had a short analysis of Dr. Paine's paper drawn up, &c. J. J."

The following is an abstract of "the analysis:"

"Marked and conflicting differences of opinion prevail, relative to the proximate cause of cerebral affections. These differences we may truly ascribe to the widely opposite conclusions which Physiologists have arrived at as to the functions of the brain, more particularly of the state of its circulation. Dr. Paine instituted a suite of experiments to determine, if possible, the normal state of the brain, so far as information so derived might be connected with its abnormal changes.

"That the brain is naturally incompressible, he regards as an established truth. But, with reference to the opinion that the cranium must always be filled, he thinks 'the spaces which exist between the parietes of the ventricles, between the membranes, the skull, the convolutions of the brain, &c., are not necessarily occupied by a serous fluid, but must be, in part, pervaded by an aqueous vapour, which is, of course, susceptible of condensation, not only from the decline of caloric, but by any power exceeding its force of expansion. And so, on the other hand, the elasticity of the vapour will promote a reduction, by loss of blood, of the contents of the cerebral bloodvessels to any extent. The existence of such an elastic vapour is inferable from what is known to exist in other cavities of the body, and from what is respired from the lungs. It must, therefore, be far more strongly pronounced in the cavity of the

cranium in consequence of the exclusion of atmospheric pressure, excepting so far as this operates through the openings in the skull.'

"To get rid of sources of ambiguity, connected with the otherwise undetermined question, whether such vapor existed naturally, or was produced during changes in the condition of the brain, experiments were performed (on calves), so as to exhaust the system of its blood. With the results of Kellie's experiments Dr. Paine premises a statement of his unacquaintance, but hazards a supposition that the animals may have been so bled by Kellie as to occasion fatal syncope 'before the body was deprived of the circulating fluid; and that, as condensation of the vapour has taken place after the death of the animal, the blood has rushed into the brain to supply the vacuum. Such, indeed, would be a necessary consequence of vapour so condensed, and of any blood remaining in the aorta, the cava, or the great branches connected with those of the head. For this reason we shall always find the cavity of the skull, in the human subject, fully occupied by solid and fluid matter, to whatever extent depletion may have been carried, unless the patient may have been trepanned during life, or before any reduction of the natural temperature. It does not, therefore, follow that vapour cannot have existed within the cavity of the skull during life because it is fully occupied by incompressible matter after death.'

"The calves were experimented upon in this way: The aorta near the heart, or the descending cava, was opened, when so rapid was the hemorrhage that the heart's action ended only on the vessels' being fully emptied. Lest condensation of vapour should possibly have arisen from reduction of temperature, the head was instantly removed after the animal died. On examination, Dr. Paine '*uniformly found the vessels of the brain and of the membranes nearly deprived of their contents, and the organ perfectly blanched.*' No disproportion in the quantity of the blood was observed, whether the animal had been trepanned, or the external air excluded. The serum exhibited only '*a tinge of red*' when the brain was opened up, and, therefore, there could be but very little blood in its vessels, or those of the pia mater. Not more than half a drachm, and 'always quite as much when the animal had been trepanned,' was observed in the sinuses of the dura mater. Calves were judiciously selected in preference to dogs, being less troublesome, and probably less liable to cerebral excitement during 'an operation requiring some dissection.'

"The cranial contents were determined by comparing their weight with a bulk of distilled water equal to the capacity of the cavity. The dura mater was not included, and its sinuses were not disturbed so as to admit of the entrance of water. Here are the results:

	ozs.	drs.	grs.
1. Brain—skull trepanned	10	4	20
Water—distilled	10	4	10
2. Brain—skull trepanned	9	4	25
Water—distilled	9	2	0
3. Brain—skull trepanned	10	3	26
Water—distilled	10	2	6
1. Brain—skull entire	11	1	5
Water—distilled	10	7	20
2. Brain—skull entire	10	6	10
Water—distilled	10	4	50
3. Brain—skull entire	10	2	40
Water—distilled	10	0	52

"On injecting quicksilver into the *human* brain an equal bulk of bloody serum was always expelled. The average quantity of quicksil-

ver, on injection into the brains of animals bled to death, was 'two pounds in brains weighing ten ounces' (℥x); the sinuses of the dura mater admitted the maximum of this proportion.

"If these experiments be correct, and otherwise trustworthy, less blood circulates within the head than has been supposed; and the amount of sanguineous effusion has probably been overrated, unless the ratio be higher in the human species.

"Independently of the experiments, Dr. Paine thinks that we are authorized in believing the circulation within the substance of the brain to be slow, and the quantity of blood small. As the organ chiefly fills the cavity, little space only can be allotted to the membranes, and still less to their chief vessels. The experiments sustain the conclusions derived from anatomical facts, that the quantity of blood is much more reduced than has often been conjectured. The very sparing provision of absorbents with which the brain is provided is 'a negative argument,' in Dr. Paine's opinion, 'that the brain has less use for blood than other parts of the system, where these vessels abound.' 'To obtain a slow circulation, an abundant and equable supply of blood was required; we find this provision made. Are not those vessels large and powerful, which convey blood from the aorta to the confines of the brain? And do we not see the brain carefully protected against the force of its own circulation?' Here we cannot but admire the philosophic views entertained by Dr. Paine, which, however, the necessary limits allotted to his Article only permit us thus to glance at.—Note O p. 1121.

"The rate at which the blood circulates in the membranes is inferred to be much more active than that within the proper substance of the organ; the bulk of transmitted blood being confined to the membranes. Yet, from the tortuous course of their vessels, the circulating fluid must pass slowly compared to its progress in other great organs. It is probable, too, from such considerations, that *in health the proportion of serum varies.* If so, a variable state within the cranium is denoted; and the normal proportion of blood being ever, probably, nearly the same, it follows, in Dr. Paine's opinion, that 'any preternatural space must have been occupied by vapour.' In accordance with the results of our Author's experiments, we have these principles deduced for practical guidance, that

"'Blood may be abstracted from the brain in the same manner and to the same extent as from other organs.

"'That there takes place necessarily an *active contraction of the blood-vessels of the brain*, as the exhaustion of their blood follows equally when the external air is not admitted within the cavity of the cranium.

"'That there must be a production or expansion of aqueous vapour corresponding in bulk and elasticity with the diminished quantity of blood and the decrease of pressure from the force of the heart and blood-vessels.

"'That the natural proportion of blood found in the brain, after its copious abstraction from the system, arises from a quantity still remaining in the vessels connected with those of the head, and which rushes into the brain after death to supply the vacuum produced by the condensation of the vapour generated during the contraction of the cerebral vessels.'

"Dr. Paine argues that the living system is under the government of uniform laws. Universal contraction of the bloodvessels—a contrac-

tion greater in the extreme vessels than what is explicable by the mere loss, is observed to be attendant on the abstraction of blood (§ 746 *a*, 912, 931, 935 *b–e*, 938 *b*, 944 *a–c*, &c.). Is not a similar contraction extended to the vessels of the brain, not less from the withdrawal of blood, than likewise 'through the influence of sympathy with the vascular action throughout the body, an influence rendered still more probable by the propagation of the *sympathetic nerve along the arteries of the brain;* that the topical abstraction of blood by cupping and leeching, if not also vesication, operates by producing a sympathetic contraction of the vessels within the brain; that inflammation of the brain is relieved on a common principle; and that opposite inferences would involve the remarkable exemption of a part from the operation of general laws, and a violation of the usual simplicity of Design?' (§ 516 *d*, 756 *b*, 893 *a–i*, 915–921, 939, 974, 1039).—NOTE Q p. 1122.

"The varying changes in the circulation of the brain renders probable the existence of an elastic vapor. This, it is inferred, is rendered yet more probable from the rapid production of vapor when the temperature is at 98° F., atmospheric pressure being removed, which must be greatly the case within the cranium, and allowing, also, for 'the resistance of the circulating fluid.' 'Equal increments of temperature, by increasing in geometric progression the force of vapor, would tend to embarrass the functions of the brain. But an admirable provision of Nature guards against the occurrence of such casualties.' As the bony inclosure excludes the influence of atmospheric pressure, minus the openings at the base of the skull, 'the generation of an elastic vapor is provided, the pressure of which at 98° F. to the ratio of steam at 212°, is as $1\frac{3}{4}$ to 30. It will therefore admit of an easy condensation, such probably as would be produced by an increased determination of blood to the head, and more especially by blood extravasated;* and however the general force of the circulation may be undetermined, it is abundantly obvious, from the tortuous course of the vessels, and their minute subdivision before entering the substance of the brain, that the current is here sluggish and easily resisted, even if it be admitted that capillary circulation depends upon the *vis a tergo*, as it does not (§ 392, *c*). It will not, therefore, be difficult to imagine that there exists this farther harmonious relation, by which the ordinary force of the circulating fluid is accurately counterbalanced by an aqueous vapour.'

"The minute subdivision of vessels before entering the substance of the brain—the obstacles checking the impetus of blood from the heart's action—the absence of valves in the cerebral veins—the remarkable distribution of the *sympathetic nerve*, &c., are, in Dr. Paine's opinion, so many powerful motives for believing that the circulation in the brain is especially dependent on a specific action of the vessels themselves (§ 392 *c*, &c.). The experiments tend to show that, if vapor exist naturally, its quantity must be small. A small quantity, however, is quite sufficient for meeting the exigencies of its purpose. The vapor may yet be found, it is supposed, by subsequent inquirers, to enact a most influential part in the cerebral economy, its great compressibility admitting of rapid changes in the quantity of circulating fluid; and by which, 'in severe congestions, mechanical pressure is partly obviated, and the circulation less embarrassed in portions of the organ not involved in disease.'

"If the production of vapor under the most probable circumstances could be established, 'the uniformity of Nature, upon the questions be-

* In no other way can the largest quantities of extravasated blood be explained.

fore us, would be recognized. No longer would there exist any necessity of forming new doctrines to explain analogous changes which have acquired the force of established laws among other organs; the treatment of cerebral congestion or inflammation will be again placed on the broad principle which determines the treatment of similar affections in every part of the body; and when the organ becomes the subject of venous plethora or of high vascular action—when the carotids are beating with a violence that communicates motion to the head, while the pulse in the extremities is low, feeble, and oppressed; when also the skin is cold, and the blood, which may not be determined to the head, is accumulated about the abdominal viscera, and the heart pulsates with exhausted efforts, we shall be no longer obliged to adopt the difficult rationale, that the abstraction of blood diminishes the violence of action in the brain by its impression on the *vis a tergo*. We shall see it exerting its influence *on the vessels* within the brain, as it obviously does on those of the abdominal viscera which may be simultaneously affected by congestion; we shall not doubt that it equally induces a change of action in the vessels attended by their contraction, in all the organs that may be involved in analogous affections; and we shall the more readily assent to this proposition and abandon the notion of a diminished *vis a tergo*, when we find, as these changes progress, the pulse rises in strength and fulness, and the heart beats with more than natural energy; which now, indeed, may require the farther abstraction of blood to lessen its violence and remove the evil it originally produced; now, indeed, the *vis a tergo* may become a motive for continued depletion' (§ 498 *f*, 750 *a*, 801, 806, 811–813, 961 *e*, 965 *b*, 968, 969 *c*, 990 *i*).

"From a lengthened paragraph of highly ingenious reasoning, Dr. Paine draws a corollary—that the force of the momentum of the circulation within the brain may be determined 'with an approach to accuracy,' and that its force must be 'nearly in the ratio of the expansion of vapor at 98° Fahrenheit, removed from atmospheric pressure.' "

Although the writer of the abstract is pleased to say that "with one other extract we must reluctantly conclude this notice," I shall not repeat it here, and have omitted other parts, as not being immediately relative to my present objects.

But I will add, in conclusion, that Donder has seen the arteries of the pia mater contract when the cervical sympathetic nerve is irritated. The brain was, of course, exposed; but if contraction take place under such circumstances, it is a law which must operate in the natural condition.—DONDER'S *Physiologie des Menschen*, p. 138, 140.

SEDATIVES.

§ 1057, *a*. It will be seen in these Institutes, that, immediately following the general subject of Therapeutics, and preceding that of the Modus Operandi of Remedies, and extending from page 563 to 660, are disquisitions upon the uses of various groups of the Articles of the Materia Medica, and that among the number are Narcotics, which are considered, in part, in their aspect as Sedatives. It is now my purpose to make some general comments upon the virtues, and mode of operating, of the entire group of Sedatives, and upon the differences which prevail among the several members of the group (See, particularly, p. 583–593).

I understand by Sedatives those remedies whose general tendency is to diminish vascular action in a direct manner; though in some instances

they may at first produce more or less excitement, which is followed by diminished action as an ultimate result of the remedy (§ 891, *q*). Nay more, the excessive application of the most powerful Sedatives—loss of blood, narcotics, hydrocyanic acid, and cold, may light up inflammation or venous congestion in the brain, whilst they simultaneously exert their general sedative effects upon the system at large until the cerebral affection gives rise to constitutional excitement (§ 743, 817, 827 *d*, 950, 974 *b*, 1024). The various aspects of the *modus operandi* may be seen in § 891½ *k*.

These opposite effects, however, are not common, nor is the excitement ever strongly pronounced unless the sedative proves morbific. In the extensive class of Stimulants and Tonics we are presented with agents which illustrate, by their opposite virtues, the common attributes of the Sedatives; since it is the direct and equally uniform tendency of the former to increase vascular action in a direct manner. As examples of the two Classes, bloodletting, antimonials, hydrocyanic acid, and cold, may be reckoned as standards of comparison for Sedatives, and alcoholic liquors, spices, mints, the vegetable and mineral tonics, animal food, and dry heat, as representing the virtues of Stimulants.

There are many things, however, which may increase vascular action, and induce inflammation, which operate in virtue of some irritation they exert (such as aloes, scammony, &c.), but whose action is very different from that of stimulants. Indeed, the most powerful Sedatives, as we have seen, may become irritants in excessive amount, and excite inflammation. But they can never act as Stimulants in the proper acceptation of this class of agents, but in virtue of morbific influences of an irritating nature. Irritants produce disease when Tonics will not (§ 188–191).

It appears, therefore, that Sedatives are liable to the same qualifications as we have seen of the groups of other remedies, being liable to be more or less otherwise unless rightly administered. This qualification is more strongly manifested in morbid than in healthy states of the body. There must be a pathological condition which shall be in relation to the peculiar virtues which are denominated sedative, or no sedative effect may arise from the action of the remedy, and even an opposite result may be the consequence, as often witnessed of opium when administered in high states of arterial excitement. And I am now led to remark that the term Sedative, like many other denominations of remedies, is very far from conveying an adequate apprehension of the effects produced; for the agents so called not only reduce the properties of life, and lessen vascular action, but they exert more or less of a direct alterative effect. That effect is most distinctly marked when they aggravate or produce disease. (See INDEX, Article *Alteratives*.)

§ 1057, *b*. Again: various Sedatives will be far from being suited to many conditions of disease, when others of the group may be in the highest degree salutary. Take two of the most powerful. Loss of blood, for example, will often save life where opium would be destructive; and, *vice versa*, opium will relieve the subject of gastric spasm induced by drinking cold water, when loss of blood might destroy him. Even in some conditions of inflammation, remedies which are commonly stimulating and tonic will prove sedative when bloodletting may be at least useless. Such is the case in intermittent inflammation, after suitable depletion; since Cinchona may then succeed, when loss of blood, antimonials, &c., have ceased to be curative (§ 662 *b*, 675, 892 *m–p*). This consideration brings up the importance of looking well at the patholog-

ical distinctions among closely-allied diseases, inasmuch as Cinchona, and many other agents of active tonic virtues, are directly sedative (by their alterative action), in suitable states of the system, in intermittent fever, while they aggravate all other fevers at the same early stages; and it is only the intermittent form of inflammation, and those venous congestions which have peculiar miasmata for their predisposing causes, in which Cinchona would not also prove stimulating. So far, therefore, the foregoing tonics belong to the group of Sedatives; and they show us the difficulties of artificial arrangements of the Materia Medica. These arise mostly from the compound virtues of remedies, and often, as in the case before us, from certain important virtues being developed only by special pathological conditions; for, it is not the tonic, but the febrifuge virtue of Cinchona, and analogous remedies, which does the service in intermittents. The latter is then so completely in relation to the special modifications of disease that it transcends or counteracts the morbific action of the former (§ 150–151, and *references* there).

§ 1057, *c.* In my "*Therapeutical Arrangement of the Materia Medica*" I have given a rather different import to the group of Sedatives than is common, having placed them as a special order of Antiphlogistics. The group is composed of such as are most capable of subduing general arterial excitement in a direct manner, though some of them may be little suited to the relief of local excitement. Thus, the narcotics, when justly applied, reduce the irritability of the whole system, and moderate general excitement. But they have no great tendency to assuage local inflammations, but, on the contrary, their tendency is more frequently to increase them. In the arrangement, therefore, of the Sedatives according to the restricted sense in which I have employed the term, I have estimated their therapeutical value according to their greatest usefulness in allaying morbid irritability and sensibility, particularly the former, in their appropriate relations to certain conditions of disease.

§ 1057, *d.* We may next proceed to regard Sedatives under five subdivisions, namely, *Sedatives proper; Narcotics; Cold; Alteratives capable of nauseating, but without producing that effect;* and *Nauseants.*

The first subdivision, or *Sedatives proper*, comprises Loss of Blood, Hydrocyanic Acid, Cyanide of Potassium, Cyanide of Zinc, Ferro-cyanide of Potassium, Cherry Laurel, Bitter Almonds, Hydrosulphate of Ammonia, Foxglove, Tobacco, Indian Tobacco.

The second subdivision, or *Narcotics*, embraces Opium, and its preparations as arranged in the order of their therapeutical value, Henbane, Poison Hemlock, Lupuline, Lactucarium. Add also the "*Senso-Paralysants*"—Belladonna, Aconite, Stramonium, and Delphinium.*

The third subdivision consists of *Cold* only, and in its local action.

The fourth subdivision consists of Tartarized Antimony, to which Ipecacuanha might be added.

The fifth subdivision, or the *Nauseants*, refers to such agents as are sedative only when they produce nausea. There are many of this denomination, but none of them are of much use in medicine as nauseants; but, on the contrary, they are apt to produce an injurious irritation of the gastro-intestinal mucous membrane when carried to the extent of nausea. They are, therefore, not specified in our group of Sedatives.

§ 1057, *e.* Now, there are certain well-marked analogies among all the foregoing subdivisions, yet each differs from the others in some very prominent characteristics. Indeed, there are no two of the remedies,

* See NOTE NN p. 1141.

however allied as Sedatives, which do not present some strong peculiarities. Take, for example, the first two of the first subdivision—loss of blood and hydrocyanic acid. These are the most immediate and powerful sedatives, in our acceptation of the term, yet each has its own peculiar mode of reducing irritability and vascular excitement, nor do they modify irritability and vascular action alike. Each, however, as with all other Sedatives, depresses irritability and action, and this is the only strong point of resemblance. The special differences consist in the different modes in which each Sedative *alters* irritability and action in their *kind* (§ 854, 895–901; also INDEXES, *Alteratives*). It is an ignorance or neglect of this philosophy, and too often a contempt of all inquiry into the *modus operandi* of remedies (shut out, indeed, by the prevailing chemical doctrines of disease), which leads to a vast amount of malpractice, and, in respect to the most important of the agents now before us, which has prompted the substitution, in otherwise enlightened quarters, of opium, digitalis, tobacco, aconite, veratrum viride (§ 891 *c*, 960 *a*, 1065)—ay, even stimulants and tonics, for loss of blood and tartarized antimony, and often, too, where bloodletting is indispensable to life.—NOTE H.

Besides what has been now said of the more prominent distinctions among Sedatives, there are others less distinctly marked among such of the agents as are most nearly allied, as the Narcotics. These, however, have been already indicated under the subjects of *Narcotics*, *Therapeutics*, *Vital Habit*, &c. But it is more remarkable that some of the Sedatives which have no point of resemblance, except in their effects upon morbid conditions, bring about alterations, or changes in kind, of a corresponding nature; as loss of blood and tartarized antimony, for example, in their subversion of inflammation and fever. But the same remarkable characteristic is strongly pronounced among many other remedies; as in the control which Cinchona, Arsenic, and Cobweb exert over Intermittent Fever (§ 892 *aa–c*, 900, 904 *c*, &c.).—See NOTE EE p. 1133.

§ 1057, *f*. It is commonly said that "Sedatives exert their effects especially upon the nervous system." But this is far from being the case with loss of blood and the antimonials, and only in a restricted sense as regards those agents which have the greatest relation to the nervous system. The nervous power is certainly involved throughout. But this is also true of all other agents whose effects reach beyond the direct seat of their operation. All exert their primary action upon the parts to which they are applied; and when the nervous power is brought into operation, it is, as extensively set forth in these Institutes, by a transmission of the remedial influences to the nervous centres, and a consequent determination of the nervous power either upon the organic constitution of the brain or of other parts. If the action be exclusively local, the nervous system participates only as a part of compound tissues, not by reflex action unless through local centres (§ 746 *c*). True, this doctrine has no relationship to those physical ones which render the Science of Medicine as simple and mechanical as the business of a shoemaker.

But, do not some of the Sedatives affect particularly the nervous system, its central parts especially, just as other agents affect particularly other parts, as cantharides the bladder, ergot the womb? &c. Certainly; and this is especially true of the Narcotics. In excessive doses their main fury is expended upon the organic constitution of the brain, and venous congestion of that organ is one of the invariable consequences. But this is effected through a very different process from what has been

hitherto supposed. The result is partly due to the reflex action of the nervous power, in a modified condition, upon the capillary vessels of the brain and spinal cord, but also more or less upon the heart, the stomach, &c. (§ 228, 230, 508, 509, &c.). The intensity of the general effects upon the system at large will often depend more upon the determination of the nervous power upon important organs remote from the brain, than upon the amount of influence exerted by the nervous power upon the organic properties of the brain and spinal cord. The general reflex action may be so sudden and violent, as in the case of hydrocyanic acid, that it shall destroy the life of the heart, the lungs, &c., without leaving a trace of its influence upon the brain; as is seen, also, in sudden deaths from blows upon the epigastric region, surgical operations, &c. (§ 476½ *h*, 508–510, 828 *c*, 904 *b*). At other times, as with opium, the remote effects may depend much upon the morbid change which the agent may establish in the nervous centres. But, in its ordinary medicinal doses, opium exerts no such morbific effect upon the nervous system; when it rouses and modifies the nervous power in degrees of intensity which are not morbific (if the remedy be properly adapted to the pathological conditions), and in the same general way as all other remedial agents, but in a way, also, both as to degree and modification of the power, peculiar to the virtues of the narcotic (§ 227–229, and *references* there). It is this special modification of the nervous power, and its reflected alterative action upon various parts, which lessens and otherwise modifies the irritability, sensibility, and, of consequence, the organic actions, of all parts of the body (§ 891½ *k*, 893 *a*, *c*, 904 *a*, *b*, 1059).

§ 1057, *g*. Cold is generally local in its operation so long as it is confined to a limited portion of the surface of the body, and it is scarcely beyond this local effect that its operation as a sedative is witnessed. Its reflex nervous actions are mostly of a stimulating nature. In its local aspect it operates alone upon the organic constitution of the part, as seen in its effects upon superficial inflammations. But there are remarkable reflex influences, as when a current of cold air striking the neck or chest occasions rheumatism, catarrh, pneumonia, &c., or when exposure of the feet to cold arrests menstruation.* There is, also, a still more remarkable and very uniform effect of this reflex nervous action, but not of a morbific nature, in suddenly increasing the excretion of urine; and if with this phenomenon be associated the powerful effect of fear as a diuretic (§ 892¾ *b*), there will be seen a display of results which demonstrate the analogy between physical and mental causes and the nervous power, and how the latter is developed by the former and participates as an exciting or modifying cause in all the remote effects (§ 224–227, 233⅘, 475½, 493 *cc*). Again: when cold operates with great intensity upon the whole surface of the body it occasions lethargy and venous congestion of the brain. The philosophy is the same as when hydrocyanic acid produces cerebral congestion. (See Essay on the greater action of Cold, in *Med. and Physiolog. Comm.*, vol. ii., p. 590–602.)

The great variety of effects which Cold is capable of producing, besides those to which I have adverted, such as its invigorating influences when applied in the form of a shower-bath, both in health and many chronic maladies, &c., are among the plain things which illustrate the important agency of the nervous power in transmitting the influences of remedial agents from the direct seat of their operation to distant parts, and show us how readily and with what intensity this power may be brought

* See also Brown-Séquard's experiment of immersing the hand in cold water, p. 807, § 1044.

into operation by any of the substantial agents of the Materia Medica, or by morbific causes, while its universal manifestations in healthy states of the body, or as disease of one part gives rise to disease in other parts, establish the philosophy of our whole subject upon one common physiological ground of alterative reflex actions of the nervous system.

§ 1057, *h.* I have placed Tartarized Antimony in a subdivision by itself, though many would probably arrange it with the Nauseants. But the former produces very powerful sedative effects without exciting nausea, as seen in the manner in which inflammations and fevers yield to its quiet influence. But the principles concerned are exactly the same in all the cases; though great variety arises throughout the whole, even in respect to each individual agent, and according to its dose, the frequency of administration, the precise pathological condition, the nature of the organ affected, and many other modifying contingencies. As it respects Tartarized Antimony, its influences involve a very important modification of the simply sedative principle. This is its alterative power, and by which it is rendered of the highest value in the treatment of diseases (§ 150–151, 841, 857, 863 *d*, 892$\frac{4}{5}$ *g*, 902 *g*, 904 *bb*, 476$\frac{1}{2}$).

§ 1057, *i.* Finally: the group of Sedatives is designed mainly to bring into connection a number of remedies which have certain important analogies, but variously and often greatly distinguished from each other, that they may be considered comparatively; with a view to enlarging our knowledge of the relationship of remedies, their points of difference, their modes of operating, &c. It is, however, more artificial than any other group, and is of very little use for practical purposes.

The Sedative Effects of Cotton-wool and of Castor Oil.

§ 1057, *k.* In connection with the foregoing subjects, I shall briefly indicate certain apparently sedative virtues belonging to common Cotton and Castor Oil, as resulting from my own experience.

In the edition of my *Materia Medica and Therapeutics* of 1848, I remarked that

The virtues of *Cotton-wool* appear to be more than of an ordinary mechanical nature. It is evidently alterative as well as quickly sedative; and, doubtless, these remarkable effects are owing to some very peculiar mechanical influence. The Author has employed it with the happiest effect in poisoning by the Rhus toxicodendron; particularly in his own person, where the hands and arms were severely inflamed, swollen, and deeply ulcerated. The relief from suffering was immediate, and the dressing was not removed till restoration had become complete. The case had baffled other remedies.

I know not whether the remedy has been submitted by others to trials beyond its well-known uses in burns and scalds, excepting by Mr. Jones in cases of ulcers, who appears to have derived the same benefit from it as myself (in *London Lancet*, Dec., 1850).

Very lately I had in charge an obstinate ill-conditioned ulcer upon a highly varicose leg of a lady of delicate health, attended, also, by an intense cutaneous inflammation surrounding the central half of the limb from the knee to the ankle, and which was studded over with a crop of suppurating eruptions. There was also a painful sense of burning and itching. Failing of all relief from the usual remedies, excepting a moderation of the sense of burning and itching from cold bread and milk poultices, I resorted to the cotton-wool, the effect of which was rather

astonishing. The painful sensations were immediately removed, and the cure completed in about a week, though a dry, thick, hard scab had then formed upon the ulcer, which became detached in five days afterward, when an elastic silk stocking was applied to the varicose limb. This occurred in the hot weather of June.

A large mass of the wool should be applied, so as to form at least an inch in thickness when bound down by a bandage; and thus far in my experience it should not be disturbed till there is reason to think that it has fulfilled its purpose. But, having never been in pursuit of new remedies, my experience in this particular is less than it otherwise would have been. I think, however, that there can be no doubt of the great superiority of cotton-wool to other means in the foregoing and analogous affections, even if it be necessary to remove the dressing frequently, as in cases of inflamed and chapped nipples. But even in these cases the cotton should be closely applied by means of a bandage. In the case of ulcers, it appears not to be of much importance that they should be in a favorable state for healing, though I regret that I have not tried the remedy in any of an eroding or malignant nature. It should be said, however, that the co-operation of constitutional means must often be necessary in the unfavorable cases which are not malignant, and that in the latter we may hope for only a palliating effect.

§ 1057, *l.* Of *Castor Oil* I remarked, in the same work, that the Author called the attention of the Profession to the special alterative influences exerted by *Castor Oil* upon the *Liver* in his *Letters on the Cholera Asphyxia of New York*, and again in the *Medical and Physiological Commentaries*, and the alterative virtues of this remedy appear now to be extensively appreciated. I also said that, when frequently repeated (as every day, or every other day), it is commonly necessary, and pretty early, to reduce the quantity from one or two table spoonfuls to a teaspoonful, or even to a fourth of a teaspoonful, the remedy being remarkably cumulative in its effects. This is greatly owing, however, to the specific action of Castor Oil upon the Liver, and the consequent increased production of bile. It is often peculiarly efficacious when exhibited a few hours after calomel or blue pill; is very useful to overcome habitual constipation, on account of its alterative action upon the Liver, when it should be given in small doses every evening (§ 556 *b*, 889 *m*, *mm*). Other comments follow upon its important uses as a cathartic for children, and for pregnant women, and in dysentery, scarlet fever, chronic hepatic affections, &c., and after convalescence from acute diseases, but always in such carefully regulated doses as shall not produce intestinal pain and mucous discharges. When thus regulated in dose, its specific action upon the liver in inducing a free secretion of bile is greater, in a general sense, than calomel or blue pill, and very often more usefully alterative (§ 857). It cannot be too strongly insisted that the dose should be accurately adjusted to the existing condition of the intestines. If it produce griping, or frequent or mucous discharges, the dose has been too large, and the useful effects of the remedy will have been lost, or disease may be aggravated, especially if seated in the alimentary canal.—*See, as to mercurials and the liver* § 1058 *b*.

I now come to the special object of this paragraph—the *soporific* virtue of Castor Oil, and this I shall present in an extract from my *Lectures*. Thus:

There is another remarkable peculiarity about Castor Oil, which, like

its special action upon the liver, and its cumulative effects, you will not find in the books. It is that of exerting a *soporific influence;* often calming restlessness, both in children and adults, soon after its exhibition. Nor does it, like many other cathartics, excite the general circulation in active forms of inflammation and fever, where bloodletting is not premised, if given in proper doses (§ 871). And, on account of its anodyne and soporific effects, I often exhibit Castor Oil in the evening in cases where I should delay all other cathartics, unless the mercurial, till morning (§ 863 *d*, 889 *n*). But it should be borne in mind that Castor Oil, in full doses, is apt to operate within four or six hours after its exhibition, and therefore, if given early in the evening it should be in such moderate quantities as may not be likely to disturb the rest of the patient by its cathartic effect before morning (§ 889, *n*). Having always observed this precaution in my practice, I have generally left instructions to repeat the same dose if necessary, or often a smaller one, at some hour in the morning, or, perhaps, only an enema of warm water. I have thus found the dose administered in the evening to have been very useful, though it have not operated as a cathartic. At other times, both in acute and chronic diseases, I have administered small doses of the Oil (as a teaspoonful or less), at intervals of four to twelve hours, with the intention of delaying a cathartic effect till some two or three doses shall have been administered—for the sake of its slowly alterative action upon the liver and intestines (§ 857, 859 *a*, *b*, 863 *d*, 873, 902 *i*, **905** *a*). This method is pursued in susceptible states of the intestines, and often in the advanced stages of all diseases, and during convalescence. The ultimate result is generally a copious production of bile.

ALTERATIVES.

§ 1057½. It will be seen, by referring to INDEXES, that the subject of this article has been variously discussed in its relation to particular remedies; and I shall now make some general remarks upon the group of Alteratives as assembled in the Author's Materia Medica and Therapeutics.

Many of these agents are derived from groups that bear other denominations; as some of the best, for example, are included among the Cathartics and Emetics. But many of them belong alone to the group before us; and such of them as occur among remedies of other denominations are reduced to the group of Alteratives merely by their diminished doses and greater frequency of exhibition. And, although these last are, respectively, the same substances under different denominations, they are very different remedies, in certain practical respects, as they may stand in one group or another; though they may act upon disease in a more or less corresponding manner in whatever doses they may be employed.

But there is a general characteristic belonging to the so called Alteratives, as intended in this work, which assembles them into a group. That characteristic is their insensible operation compared with the members of other groups; and their action is to be appreciated only through certain inconsiderable phenomena, and through the subsidence of disease under their quiet influence—as when arsenic, or quinine, or cobweb operate in the cure of intermittent fever. When other remedies belonging to this group produce some prominent local effect, or are more serviceable in their operation in certain large therapeutical doses, they are,

in such cases, ranked under other denominations. Such is the case, for example, with tartarized antimony and ipecacuanha, which, in certain therapeutical doses, operate powerfully as emetics; whilst, in their acceptation as Alteratives, their doses are comparatively small and often repeated, so that they operate in an insensible manner, though their essential influence upon morbid states may be the same in whatever doses employed. In one case, or by their emetic action, they may produce sudden and great influences upon morbid conditions, alter them very speedily, and place them at once in the way of their natural return to a state of health. In the other case, or when employed in their small and repeated doses, they bring about the same salutary changes or alterations without exciting even any nausea (§ 516 *d*, No. 6, § 902 *g*). It is therefore evident that these substances, like many others of the group of Alteratives, may be, in reality, more immediately and profoundly alterative when employed in full doses, as Emetics for example, than in their small doses under the denomination of Alteratives. But it is also true that both tartarized antimony and ipecacuanha are curative of a vastly greater range of diseases in their small and frequently repeated doses than when administered as Emetics. It is also readily apparent that the same general remarks are equally applicable to calomel, blue pill, colchicum, &c., which are cathartic in certain doses, but powerfully, though more slowly curative in such small doses as do not produce purging, and which, therefore, in these small doses, I call Alteratives.

There are many things, however, which are as insensible in their operation as our group of Alteratives that are not included in this group, particularly the Tonics and Astringents. But the remedies belonging to these denominations are very peculiar in their effects, which are a good deal allied as the remedies may belong to one denomination or the other. This common characteristic serves, therefore, as a basis of arrangement for either group. But, in the case of the Alteratives, the want of any general correspondence in the immediate effects of its several members (with certain exceptions which are grouped into subdivisions), and the absence of any direct and well pronounced result, have led to this denomination.

It is thus seen that the denomination of Alteratives belongs properly to all positive remedies, since it implies the absolute effect of all agents that are truly remedial, whether physical or the salutary emotions. That is to say, they produce such alterations of the morbid conditions as enables Nature to accomplish the cure, or, more critically, the morbid organic states are so altered to a condition less profoundly morbid, as enables them to return spontaneously to their natural type (§ 853–856, 896–901).

Although, as we have variously seen, all agents which exert effects upon parts remote from the seat of their direct operation transmit their influences through reflex action of the nervous power, the Alteratives bring it into action somewhat differently from those agents which, like Cathartics, and Emetics, and Loss of Blood, operate suddenly and with great power, especially when the Alteratives are administered in their usual small and repeated doses. They then develop the nervous influence progressively and continuously, and therefore bring about changes in the morbid states in a gradual manner; while in the other cases the changes are introduced abruptly (§ 222–233$\frac{4}{5}$, 516 *d*, No. 6, § 551, 552, 556, 841, 863, 867, 894–896, 902 *e–f*, 904 *bb*, 476$\frac{1}{2}$ *h*, 905, &c.).

It will be seen, therefore, that the distinctions which are made of remedies into Cathartics, Emetics, Expectorants, Astringents, &c., are merely arbitrary, and for the sake of convenience. As we have variously seen, also, Cathartics, Emetics, &c., do not primarily cure by the evacuations they produce, but essentially through their alterative action. The evacuations or redundancy of the secretions are only consequences of changes which the remedial agents effect by their alterative action (§ 863, 889 *f–h*); and while Cathartics, for instance, are employed in introducing such changes in the functional condition of the intestinal mucous membrane, those very changes lead to all the alterations which take place in diseased parts remote from the intestinal canal (§ 889, *f*). Whatever part the redundant products may contribute towards the cure of disease, they are not only the result of the alterative action of the remedies, but their own tributary influences are of an alterative nature, and mostly through the same principle of sympathy that governs the remote action of the agents employed. It is the same as in § 944 *c*.

Many Alteratives, in the sense implied by the group now under consideration, are remarkably applicable to a vast range of diseases; but nearly all the diseases, to which any of the members of this extensive group are suited, are the various phases of inflammation and fever. Hence the group forms one of the Orders of the class of Antiphlogistics.

Those Alteratives which are of this universal nature I have assembled, in the order of their general therapeutic value, under the denomination of *General Alteratives adapted to inflammatory and febrile diseases in a general sense.* They are more or less suited to all the varieties of inflammation, whether acute or chronic.

There occurs another general assemblage which are more especially adapted to specific forms of inflammation and fever, and these are arranged under subdivisions according to the specific forms of disease for which they are employed, and in the order of their relative value. The following are the subdivisions:

1. Adapted to scrofulous, and some other specific chronic inflammations.
2. Adapted to syphilis, and certain other specific chronic inflammations.
3. Adapted to syphilis complicated with scrofula.
4. Adapted to rheumatism and gout.
5. Adapted to intermittent fever, intermittent inflammation, and other intermitting diseases.
6. Adapted to obstinate and chronic cutaneous diseases, carcinoma, elephantiasis, &c.

Our class of Antiphlogistics embraces, also, a group of Alteratives which are designated as *local*, on account of, particularly, their application to the surface of the body. This, also, is an extensive group, and is divided into *Constitutional Alteratives*, or such as extend their effects by *remote* sympathy, and of which there are but few; and, secondly, *Limited Alteratives*, whose action is limited to the part to which they are applied, or extended only by *continuous* or *contiguous* sympathy (§ 497–498, 818½, 893, 905, &c.).

As all this practical grouping of remedies is relative to principles embraced in these Institutes, I formerly introduced the disposition which I have made of the Order in which the group of local Alteratives occurs. Unlike the Alteratives which are employed internally, the present assem-

blage does not appear as an order, but as a division under an Order of *Cutaneous and other Local Affections.* (See p. 643, 644.)

These Alteratives (p. 643), which are employed locally, may operate either constitutionally, through reflex nervous influence, like the internal alteratives, as the mercurials, or in a more circumscribed manner through the ganglia or other centres of the sympathetic nerve, or only superficially, as with Suppurants, Escharotics, and Sedatives; but Vesicants, which are embraced in the group, always exert useful effects upon internal maladies through reflex action of local nervous centres (p. 642–648, § 893 *a–f*, p. 652–655, § 893 *m*, p. 657–659, § 893 *p*, p. 679–681, § 905 *a*). Other remedies included in the group must also operate upon internal parts through local centres of nervous influence (§ 497, 1038), such as Aconite in the relief which it affords to neuralgia. I have relieved a very painful neuralgic affection of the whole extent of the sciatic nerve in fifteen minutes by rubbing along its course an ointment of aconitin, which had refused to yield to other remedies.—The extensive subdivision which is designed for diseases of the skin supplies examples of a purely local action upon the organic properties of the part without the auxiliary aid of nervous influence (§ 658). Some of them, however, will also exert constitutional effects through reflex nervous influence, such as the mercurial ointments (§ 514 *d*, 826 *d*, &c.). Remedies of that nature, therefore, are arranged also in another subdivision, indicating their extensive constitutional influences through the medium of the skin and nervous system (§ 891½ *g*, 893 *a*, 1059, 1088 *b*, 904 *b*).*

The foregoing details, and some others of a corresponding nature, are farther designed to exhibit the advantages of the Author's system of a Therapeutical Arrangement of the Materia Medica.

§ 1057¾. I shall now introduce a series of important remedies, not only for the purpose of examining their special uses, but particularly for a farther illustration of general principles in Medicine, and the Philosophy of Organic Life, for which this work is especially designed (§ 1062½).

CHLORIDE OF MERCURY, AND THE BLUE MERCURIAL PILL.

§ 1058, *a.* I shall speak mostly of Calomel as employed in full doses for its cathartic effect; and this for the purpose, especially, of indicating its remedial virtues. Its smaller and more repeated doses, however, will be the subject of remark; though, in whatever doses exhibited, it is its alterative action which bestows the service (§ 889, *a–g*), which, indeed, is true of most other remedial agents (§ 516 *d*, No. 6, § 638, 863 *d*, 896, 900, 902 *g–m*, 904 *d*, 905, and INDEXES, article *Alteratives*).

I need not say that Calomel is rarely actively purgative, although it occupies the first rank among Cathartics in my Therapeutical Arrangement of the Materia Medica, or that, to procure a cathartic effect, it is commonly associated either with Jalap, Aloes, Rhubarb, Podophyllum, Colocynth, Scammony, Gamboge, or Extract of Butternut, or, if exhibited by itself, some other cathartic is generally prescribed within a few hours afterward. The combinations, too, with the several articles are most useful, in a general sense, in the order in which I have now stated them. Thus, Calomel and Jalap are more extensively useful than Calomel united with any other cathartic. Podophyllum resembles Jalap in its action, but is much inferior; so that Aloes is the next adjunct on account of its adaptation to a great range of chronic affections of the di-

* NOTES DD p. 1132, EE p. 1133.

gestive organs, and next Rhubarb, and so on; and it is well known that it may be often useful to blend two or more of these together along with the calomel. But the merits of each individual case should, of course, be brought to bear upon the right combination at the time of prescribing (§ 150–151, 857, 870 *a*, *b*, 872 *a*, 888 *a–c*, 1061).

As I shall soon set forth, however, it may be often most useful to exhibit Calomel uncombined, and to administer some other cathartic at an interval of some hours afterward. For this purpose Castor Oil generally surpasses all others (§ 1057, *l*); and, next to this, in a general sense, we may reckon Jalap combined with Tartrate of Potash (§ 1060); and next, the neutral saline cathartics (§ 1061); and next, Rhubarb along with Calcined Magnesia and the Tartrate of Potash and Soda (§ 872 *a*, 1061). We need rarely go beyond the cathartics which I have now mentioned, as ultimate aids to Calomel, with a view to purgative effects. But it should be always considered that it is the alterative action, the direct influence upon disease, that is to be chiefly regarded in the choice of these remedies, and of none is this so true as of Calomel. Hence it is evident that the precise circumstances of the disease must determine the choice (§ 872 *a*, 883 *a*, 888 *b*).

But, though Calomel be not actively purgative, it is powerfully alterative, and, in doses that are felt, it is never negative in its effects. It alters the condition of disease either for the better or for the worse—too often for the worse (§ 854). There is no other remedy that requires more skill for its right administration—none, with the exception of loss of blood and tartarized antimony, that reaches more profoundly diseased conditions, or which will so often turn them to health, when wisely employed. And so, on the contrary, it is capable of inflicting great injury if not suited to the case.

§ 1058, *b*. Let us then consider, in a general manner, some of its useful effects when employed in full purgative doses. Its action is mostly exerted upon the stomach and duodenum. Here its first great curative impressions are made, and from these parts powerful reflex nervous actions radiate over the whole system, though more so upon some organs than upon others. Its effects are most strongly pronounced in some of the glandular organs, especially the liver; and hence it is peculiarly suited to diseases of that organ in many of their phases. But its action upon this, and other parts remote from the stomach, will depend upon the manner in which they may be affected by disease; for we have variously seen that the susceptibility of tissues to the action of remedies is not only increased by disease, but will be influenced by its exact condition—than which there is nothing more important to be known (§ 129 *h*, *i*, 134, 137 *d*–151, 240, 324, 556 *c*, 650, 662, 674 *d*, 675, 854 *bb*, 855, 859, 870 *aa*, 871, 888, 892 *c*, 892½ *a*, *b*, 892⅘ *d*, 970 *c*, 1063 *b*).*

When the whole system is invaded by disease, as in idiopathic fever, we may anticipate a universally favorable impression when this remedy is rightly applied; and this, too, whether employed in its largest or its smallest therapeutical doses—though, as a gradual alterative for this purpose, Tartarized Antimony is much better (§ 148, 557 *a*, 841, 892 *c*, 900, 902 *i*; and INDEXES, *Alteratives*). When active inflammation affects any part, we may generally calculate, if there be no objection to its use, that a few grains of Calomel will reach that part advantageously, especially if Blood-letting have been premised (§ 672, 868, 871, 889 *g*). And yet, under circumstances of health, the same dose might have no

* Calomel and blue pill rarely increase the bile in health. Hence the great fallacy of Dr. Scott's late experiments with mercurials upon healthy *dogs* (§ 694 *b*, 857 *cc*, 854 *bb*).

effect upon the same organ. This, however, is constantly more or less true of all other remedies.

We have thus before us two great leading facts—that, in fevers, and acute inflammations, especially if the latter affect any important organs, the next great curative means after bloodletting, if the latter be required, is, in a general sense, Calomel, in at least one dose, with a view, in part, to a cathartic effect, though carefully regulated as to quantity. Whether a full dose should be repeated, or whether in any dose, and with what frequency, will then depend upon the peculiarities of each case. The general affirmation can be made with greater certainty, that one full dose will be proper and useful in the early stages of disease, than we can pronounce upon the probable advantages of its repetition. But, it is a very common circumstance, where it may be inexpedient to carry this remedy beyond one or two full doses, that Blue Pill may be afterward exhibited with happy effect, when the continued use of Calomel would have been injurious.

§ 1058, *c*. This correspondence between the virtues of Calomel and Blue Pill leads me, now, to speak of them comparatively. Notwithstanding their affinities, they are well known to exert effects which distinguish them from each other. But this difference consists mostly in the effects of one being more rapidly produced, and more strongly pronounced than those of the other. Calomel is more irritating, rapid, alterative, and positive in its action than Blue Pill; while in other respects, the general results of both are greatly analogous. The resemblances and differences in their effects may be farther illustrated by comparing them, respectively, with general Bloodletting and Leeching (§ 925, 927 *a*, 929, 939 *e*, *f*, 956–958, 966, 968, &c.).

From these analogies in their useful effects, and from their powerfully alterative virtues, it is evident that the same coincidences will be likely to obtain in their bad effects (§ 854 *c d*, 857); and such being the case, whatever I may say of the injurious effects of Calomel, and of the precautions which should attend its use, will be equally applicable, though in an inferior degree, to Blue Pill.

§ 1058, *d*. It is a well-ascertained fact that, in numerous cases, Calomel and Blue Pill have not their effects increased, beyond a certain quantity, in the ratio of the increase. Ten grains of either will often produce as great a cathartic effect as fifteen grains; or, at least, this is inferable. Beyond fifteen grains the difference is still less manifest. But below ten grains this ratio is less likely to appear; though five grains will often operate with greater effect, in proportion to the quantity, than ten grains. Nevertheless, the difference between five and ten grains, and at other times between two and five grains, is so considerable that the smaller quantity may be very beneficial when the latter would be very injurious (§ 857).

But there are occasionally some very remarkable peculiarities in the effects attending the smallest and the largest doses of Calomel, when they are regulated according to the repute which Calomel holds as a cathartic, and which are but little observed of Blue Pill. When employed, for example, in very large doses, even far exceeding the largest in common use, the cathartic effect is wholly counteracted by the peculiar nature of some present intestinal disease; or the dose may even arrest diarrhœa, as Calomel often will, also, when employed in the minute doses of a fourth or tenth of a grain. In respect to the large doses, I will quote an

example which occurred at one of the London Cholera Hospitals in 1832, where Mr. Bennett is said to have treated successfully 17 of 18 cases by exhibiting to each patient, as soon as admitted, 120 grains of Calomel, and afterward 60 grains, every hour or two, until some relief was obtained. Several of the patients took from three to four ounces. Its direct effect was that of restraining the vomiting and purging. These 17 patients recovered, and the record so far is undoubtedly true; but, from what we know of the fatality of the malignant cholera in the hands of others, after the accession of those symptoms which are diagnostic of the disease, we are bound to believe that, in most, and probably in all, of these cases there existed only the premonitory stage, as it is called, when the disease is always very easily controlled, and by much milder treatment.

It has been long known that large doses of calomel—such as 20 or 30 grains— will arrest vomiting and diarrhœa attendant on particular pathological conditions of the intestinal mucous membrane. This it does in virtue of its profound alterative power, and shows us that it is the alterative, and not cathartic, operation which contributes essentially to the cure. It equally denotes, also, an error in the imputed sedative effects of the remedy, as will be more distinctly seen in the entire failure of such doses, and of others far more moderate, in the ordinary forms of diarrhœa and vomiting, and in cholera morbus and cholera infantum. But, in these last cases, particularly in cholera infantum, and often in dysentery, we may obtain the greatest benefit from small doses of Calomel—doses, when administered in cholera infantum, varying from the fourth to the twentieth part of a grain. All of this, too, goes to demonstrate that it is not the cathartic, but the alterative virtues of Calomel which impart to it its remedial power.

These facts admonish us that we must study the virtues of remedies, and their doses also, in their relation to diseased conditions, and that we can form no just conclusions as to their remedial capabilities by any other methods of observation, and, above all, that we have nothing to hope from Organic Chemistry (§ 1058 *b*, *note*).

§ 1058, *e*. Although Calomel and Blue Pill are capable of profoundly morbific effects in many forms of disease, unless they have been preceded by other remedies, especially in miasmatic congestions of the liver and intestinal mucous membrane, where nothing may follow their precipitate use but a discharge of viscid mucus, and an aggravation of all the symptoms, I shall not prolong this article by analyses which would involve so great an amount of detail. Nevertheless, it is impossible to arrive at any just conceptions of the virtues of remedial agents without referring to their effects in various conditions of disease; nor can we obtain any correct view of their remedial capabilities by considering the operation of a particular remedy abstractedly from other means which may be associated with it in the treatment. A full dose of Calomel, for example, may be very salutary in some given form of disease, if it have been preceded by Bloodletting, as is often witnessed in congestive fevers, but without which it may be very pernicious. At another time, its good effects, or at least its best effects, can be secured only by associating with it other remedies, or, by applying others after its administration. The same, also, is more or less true of all other remedies; each one influencing, more or less, the effects of the others (§ 859 *b*, 863 *e*, 871, 872 *a*, 889 *k*).

§ 1058, *f*. In continuing the subject of Calomel, I shall now consider its uses in certain special forms of disease, when employed in its occasional and full doses:

And first of *dysentery*, which is seated particularly in the lower tract of the mucous tissue of the large intestine, though all the digestive organs are more or less involved in morbid action. But the burthen of the disease is upon the mucous membrane, where it probably consists at all times of a peculiar modification of inflammation, though differing, in different cases, according to the nature of its remote causes (§ 644–666).

Now, the treatment of this disease, not only by Calomel, but by other remedies, will be influenced by the nature of the remote cause; and this will be ascertained by the phenomena, and by tracing up the history of the patient for one or more months anterior to the attack. Its principal causes are, mainly, two: 1st, crude, indigestible food, acting in conjunction with changes of weather, and other common atmospheric influences. 2d, miasmata, from decaying vegetable matter.

The first of these modifications is sporadic, and comparatively mild. The second may present only sporadic cases, but is apt to occur more or less epidemically, and is vastly the more obstinate and fatal form. Each variety demands essential differences in the details of treatment, though the same general principles are applicable to all the modifications. It should be also premised that the miasmatic form is attended with a special condition of hepatic congestion, which is one cause of the greater obstinacy and fatality of this variety of the disease, and which has a considerable bearing upon the treatment (§ 650–652, 806–816).

With these premises before us, we are now chiefly interested about the adaptation of Calomel to dysenteric disease, with a view especially to its local effects. But, it is impossible, as I have said, to give any intelligible account of the proper use of one remedy, especially such a remedy as Calomel, without speaking of it in connection with other remedies which may, or should be, associated with it. We have formerly seen that, when active inflammation is seated in the intestinal canal, cathartics are hazardous till the disease has been more or less subdued by other remedies, especially Bloodletting. Calomel, however, does not irritate in the same way as other cathartics. But it will often do what is much worse in muco-intestinal inflammation. It may not only increase its severity, but so modify its character as to render it very malignant, as in another example of a common abdominal affection to which I have adverted, and also in scarlet fever. In such circumstances, it never fails to affect the liver injuriously also. It has been therefore found, in the best experience, to be the most successful and speedily curative practice to abstract blood from a vein, or at least by Leeches, as the first remedy, in cases of dysentery of much severity (§ 991, *b*). But this is not commonly done, and Calomel is apt to be relied upon as the principal remedy. It is a prevailing practice to exhibit, at the onset of the treatment, from 10 to even 20 grains of Calomel, and not unfrequently to repeat this dose from time to time. When the disease is of the milder variety, if other things go right, it will often succeed in the end; though not so readily, and less frequently than when Calomel is given in doses of two to five grains once in twelve or more hours; and, in many cases, a grain or less of Ipecacuanha, also, once in four or five hours, with more or less of some preparation of opium. A large medication by Calomel in any condition of dysentery is not a reliable, but

often an injurious practice. When proper bloodletting has not been employed, if the inflammatory symptoms do not soon yield, all internal means should be suspended, and General Bloodletting, or Leeches to the verge of the rectum, or a blister, or warm poultices, to the abdomen, should be applied, and perhaps in succession. Alterative doses of ipecacuanha may often become very useful, perhaps Blue Pill, but more probably well-regulated doses of Castor Oil (§ 1057, *l*).

So much for the milder, or sporadic form of dysentery. Coming to the miasmatic variety, especially when prevailing epidemically, the Practitioner who does not regard the modifying nature of the remote predisposing cause, and the exact pathology, will prescribe empirically, and be apt to administer large doses of Calomel, which, in this condition of the disease, will be very likely to destroy the patient. Or, if he depend upon astringents, or administer Rhubarb as is often done (§ 1062), or resort to Tonics and Stimulants, nothing but disappointment will await him. General Bloodletting, often followed by leeching, is here the great remedy. But, however we may subdue the morbid condition by loss of blood, with the aid, also, of blisters, abstinence from food, &c., we shall generally find that Calomel must be managed with great prudence, or the disease will not only be aggravated by it, but rendered more malignant.—NOTES FF p. 1135, GG p. 1138.

As to Loss of Blood, Nature also proclaims in this variety of dysentery, more distinctly than in the sporadic, the true principles of treatment, for here the effusion of blood from the intestinal mucous membrane is greater; and this is plainly the remedy which Nature institutes for her own relief (§ 805, 862, 863 *e*, *f*, 890 *d*–*g*, 1019).*

§ 1058, *g*. In respect to *fever*, most of its varieties derive, at their early stages, great benefit from a full dose of Calomel combined with Jalap and a grain or two of Ipecacuanha; or it may be most useful, in many cases, to exhibit the Calomel uncombined, and to administer Castor Oil, or a combination of Jalap and Tartrate of Potash, a few hours afterward. If an emetic be also indicated, a full dose of Ipecacuanha, perhaps with Tartarized Antimony, may be preferable to the latter remedies; so that when vomiting begins, purging will generally take place simultaneously. In this way prodigious alterative influences will be exerted, and if employed near the invasion of disease it may be arrested at once (§ 557 *a*). But it often happens, as has been variously stated in this work, that bloodletting should be premised, and this, especially, if there be any local inflammations or venous congestions, which are often present at the invasion of the constitutional malady.

§ 1058, *h*. When Calomel is employed in the treatment of *Scarlet fever*, it should be with great caution after the disease has advanced somewhat into the eruptive stage. At this period, Calomel, Senna, and Rhubarb have done a vast amount of mischief. At or near the invasion of Scarlatina, when the symptoms are severe, a moderate dose of Calomel may be useful. Nevertheless, severe forms of this disease not unfrequently occur in which Calomel, administered at the very onset of the attack, proves detrimental. If doubt exist as to the propriety of the remedy, Castor Oil should be substituted, and perhaps little else should be done (§ 858, 861). It may be also safely affirmed that Calomel should be rarely exhibited after the disease has run its course for some two or three days; not often, indeed, when the eruptive stage has existed for twenty-four hours. It will then aggravate the abdominal conges-

* In mild forms of dysentery there may be an absence of blood, or the mucus only tinged.

tions, and often convert a mild into a malignant form. And here, too, when Calomel affects the digestive organs perniciously, the salivary glands often swell up suddenly from sympathy, and, not unfrequently, the throat becomes ulcerated, gangrenous, &c. But these are only secondary results of a far more alarming condition of disease in the abdominal organs. The swelling of the glands, in these cases, is not at all owing to the direct specific effect of mercury upon them, as in cases of salivation, nor is there any attendant flow of saliva; but it is the result of a highly aggravated state of the morbid condition of the abdominal organs, inflicted upon them by this remarkable agent. The glandular swelling which often occurs spontaneously from the same visceral cause, presents a far milder form. There is not generally, however, much danger from the swollen glands, or from the sphacelus of the fauces, so only they be not allowed to remain a source of constitutional irritation. One may be relieved by a stick of lunar caustic, and the other moderated by leeches and warm fomentations. What is thus witnessed about the throat is only an index of a far more fearful evil in the great organs of life. In these cases Nature, mainly, must work out the cure (§ 816 *b*.)

For the grave forms of Scarlatina, I am apt to prescribe a small dose of Calomel at the beginning of the disease, but never repeat it; and as for the rest, I depend upon cautious doses of Castor Oil, as far as may be indicated by the state of the abdominal viscera (§ 1057, *l*).

I may finally add that, in all mild cases of scarlet fever, no risk should be taken from Calomel. It is not then wanted; and I have seen the mildest converted into malignant cases by imprudent doses of Calomel, and by Senna, Rhubarb, and the Saline Cathartics. Indeed, so susceptible is the alimentary mucous tissue in this disease, and so peculiar is its morbid condition, that solid food, even bread, will sometimes convert the mildest into the severest cases, merely by its mechanical irritation. It should be also borne in mind that in this, as in all other strictly self-limited diseases, we cannot establish any modification of the pathological cause which will prevent its running a regularly ordained course. The natural state of these affections, in all favourable cases, is most likely to result in their cure (§ 858, 861). In the graver forms, art can only moderate their violence, or meet with appropriate remedies any incidental local inflammations that may spring up in the progress of the specific maladies (§ 137 *c*, 524 *d*, 847, 858, 870 *aa*).—*See* P.S. 1860, p. 872.

§ 1058, *i*. As to the treatment of *measles* and *small-pox*, I do not recollect to have witnessed any injurious effects from the use of Calomel, nor do I find them stated by Authors. Perhaps one reason is, that Nature has been more allowed, in these self-limited diseases, than in scarlatina, to have her own way. But here the danger from Calomel is certainly far less than in scarlet fever.

§ 1058, *k*. In *whooping-cough*, Calomel, as a cathartic, or rather for its alterative effects upon the abdominal organs, is often very salutary; and this especially so when the alvine evacuations present a morbid appearance. Blue Pill, however, is often better. Bloodletting should come in the moment that pneumonia may supervene, as it often does, and is the great cause of the fatality of whooping-cough (§ 870, *aa*). But here, as in other acute diseases, great moderation as to food is powerfully curative (§ 856).

§ 1058, *l*. In the ordinary forms of *jaundice*, whether complicated with a gall-stone in the liver, or owing alone to hepatic disease, Calomel dis-

plays some of its brightest advantages, and may be given, if apparently indicated, in doses of 10 to 20 grains, two or three times a day, with jalap, or, perhaps, aloes, or the resinous cathartics, at intervals, till the difficulty is more or less surmounted. But Jaundice is often of too grave importance to be always intrusted to those remedies; and Bloodletting must then be the principal remedy, followed, perhaps, by a blister eight or ten inches square over the epigastric region. If there be gall-stones, Cicuta may be useful in relieving spasm of the biliary duct.

§ 1058, *m*. Calomel is an admirable remedy, as it respects its transient effect, in *erysipelas*, a disease which is often sadly managed by tonics and stimulants (§ 1005, *j*). The least important part of the disease is also generally considered the most important, since, in all severe cases, the inflammation of the skin is comparatively of little moment. Now and then, however, when erysipelas springs up epidemically, the superficial inflammation puts on the phlegmonous character, when ulceration and sloughing are apt to follow; and these conditions, as well as the antecedent and remaining inflammation, form an important part of the pathological complications. But of the pathology of this disease I have spoken sufficiently (§ 970 *c*, 1005 *j*), and therefore come to the treatment.

The great curative means, in all severe cases, is early and full Bloodletting, followed by five to fifteen grains of Calomel, and this in six or eight hours afterward by Jalap and Soluble Tartar, or by Castor Oil. If, by these means, a blow be struck at the abdominal disease, the inflammation of the skin will begin to give way, and nothing more may be necessary than, perhaps, a moderate dose of Calomel, or of Blue Pill, or, more probably, Castor Oil, or Leeches to the inflamed surface. Or, Nitrate of Silver, pure and concentrated, or dilute Iodine may now be pencilled over the whole inflamed surface. But, for subduing the remaining inflammation, Leeches are the best local application, in my experience, and they are dictated by the soundest pathological principles. Nevertheless, whatever is done in severe cases should be done quickly; and, if the treatment have failed, at the onset, to sensibly mitigate the symptoms, especially the cutaneous inflammation, which is only symptomatic of abdominal disease, we may depend upon it that the latter condition calls for farther general Bloodletting, and probably for another dose of Calomel, or at least of Blue Pill, and more or less of Castor Oil. If cerebral symptoms (which are also sympathetic of the abdominal congestion) spring up, a large abstraction of blood will be indispensable.

I have never known Calomel injurious in erysipelas; but it must be added that I have almost always begun the treatment by abstracting blood, which, as I have said, is a great means of preventing the morbific effects of Calomel and Blue Pill; and no fatal case has occurred in my practice (§ 1005, *j*).

§ 1058, *n*. And now, as to *acute rheumatism*. Here, too, in all severe cases, especially of articular rheumatism, there is much attendant disease of the abdominal organs, which contributes powerfully to maintain the rheumatic affection; and it commonly happens, in such cases, that, after the inflammatory condition is subdued, there will be still remaining a considerable amount of visceral disease, which will require, at least, great simplicity of diet. In all severe cases, it will be often observed that the abdominal affection precedes the rheumatic, but becomes much aggravated as soon as the latter supervenes.

Calomel is a very useful remedy in acute rheumatism, in one or more

full doses, or yielding soon to Blue Pill, or Castor Oil, and rarely does any harm. But, in all severe cases, a free abstraction of blood should be the first remedy; and one or more repetitions of venesection, along with leeches perhaps, are often important to a speedy removal of the disease, and a fluid farinaceous diet is next in importance. Any other practice which excludes Bloodletting in severe cases will be more profitable to the Physician than to the Patient. The next great remedy for acute rheumatism, and often for chronic, is Tartarized Antimony, frequently administered in augmented doses to just short of nausea. If the heart be affected, the Loss of Blood will be so much the more important. In a large proportion of cases, the disease will yield to this practice within a week. But, however exact the treatment may be in other respects, an allowance of solid food, even bread, or of animal broths, may prolong the disease, especially the abdominal derangement, for many weeks. Colchicum should not be necessary in the declining stages, nor should opiates be employed (§ 870, *b*).

§ 1058, *nn*. The same general principles of treatment apply to *acute gout* as to acute rheumatism (§ 1058, *n*), though in a moderated degree. A full dose of Calomel, or of Blue Pill, is generally useful at the onset of the treatment, one or the other, according to the derangement of the abdominal organs. But here, if the paroxysm be at all severe, and we would most speedily relieve the patient, he should be first bled. Lastly, if necessary, and often pretty early, Colchicum may be exhibited.

§ 1058, *o*. In *pneumonia*, Calomel or Blue Pill, in one or more full doses, at or near the beginning, is generally useful, rarely injurious. But it is sometimes a better practice to obtain more of their constitutional influence by exhibiting from one to four grains of either (to adults) once in four to six hours; though this is by no means recommended as a general practice. It is better suited to advanced stages of pneumonia. If complicated with abdominal disease in the form of bilious pneumonia, they are still more indicated, but unless cautiously administered are liable to do injury. Bloodletting, however, is the great remedy for all forms of pneumonia, and next to that Tartarized Antimony, in increased alterative doses every hour or two, but kept below the point of nausea (§ 904 *bb*, 1005 *k*, 1068 *c*). Leeches and Blisters may ultimately be wanted, and perhaps more or less opium to tranquillize the cough, as appears in other places (§ 892$\frac{4}{5}$ *g*, 1005 *h*, *k*, 1017 *c*).

§ 1058, *p*. In the treatment of *croup*, which is apt to be complicated with abdominal disease, a dose of Calomel is generally useful, often very important. I generally exhibit it, in a moderate dose, along with sufficient Ipecacuanha to produce vomiting. If the symptoms do not then yield, I take no risk, but proceed at once to the abstraction of blood from the arm (§ 576 *e*, 1009–1013). There is no danger from the ordinary forms of croup when Blood-letting is applied early. But the disease advances with great rapidity, and may quickly reach a stage when all remedies will fail. If late in the disease an emetic be the first remedy, it will certainly fail if blood-letting will not succeed; or, if the latter, in being first, will effect a cure, it would be probably baffled by the prostrating effect of a preliminary emetic (§ 576 *e*, 869). I may add that I have lost but one patient of croup, and that in the early part of my professional life. It is of greater interest, however, that the child was rather the victim of the purgative action of Tartarized Antimony, administered in cautious doses about once in twenty minutes.* The croupy

* See Note Ggg p. 1151.

symptoms vanished under this effect; for there was no vomiting. I have also witnessed the death of two adult patients in the hands of other Physicians from the same cause, and where the doses given were but three grains. There was no vomiting, but an uncontrollable watery purging, no abdominal pain, pulse extremely rapid and so small as to be scarcely sensible to the touch when there was much remaining muscular strength, and entire preservation of the mind (§ 863, *d*). Nevertheless, this has not deterred me from the occasional use of Tartarized Antimony in emetic doses, especially in conjunction with Ipecacuanha (§ 675, 857, 902 *g*, &c.); and as an alterative in small and frequently-repeated doses it transcends the Mercurials in fevers, and is scarcely inferior in all acute inflammations excepting of the intestinal canal.

§ 1058, *q*. And how is it with Calomel in *acute inflammation of the brain?* Certainly important. But after one full dose it becomes most useful in doses of two to four grains once in four to ten hours. This, however, is more of the gradually alterative plan, and when more of the constitutional influence of the remedy is intended than we are now considering, especially if all purgative effect be restrained (§ 516 *d*, 860, 863 *d*, 890 *l*, 902 *i*). There should be no active purging in cerebral inflammation by irritating cathartics, as is often recommended in the books. They will propagate a pernicious nervous influence upon the brain. Calomel, Blue Pill, Jalap, and Castor Oil are alone wanted, so far as cathartics are concerned. The Drastics have been commended upon the fearful doctrine of *counter-irritation*, supplying an impressive contrast with the objections alleged against Bloodletting (§ 889 *g*, 893 *n*, 1065 *d*).

But, as I have hitherto said, Loss of Blood is our chief remedy in acute cerebral inflammation. So long as the symptoms continue to recur, they should be promptly met by General Bloodletting. Set the patient erect, and bleed him to the point of syncope. There is nothing to fear from the remedy, but every thing from the disease (§ 974–975).

Leeching, and Tartarized Antimony in its small doses, which are so valuable in other acute inflammations, are of little or no use here; and Blisters should be avoided till at least a decisive ascendency is obtained over the disease. The latter remedy should never be applied to the head, but to the neck and shoulders, unless the abstraction of blood have been carried to a great extent. In some four or five cases, after having bled the patients till the remedy became unavailing, I have rescued them by covering the entire scalp, neck, and upper part of the shoulders with a Blister. The effect was truly wonderful, as hope was nearly exhausted. But the Loss of Blood had been very great. I may add that the head should be shaved early and kept covered with ice (§ 992, 1056).

Nor may we refrain from general bloodletting in venous congestions of the brain, and at all ages, though generally in a very moderated degree (§ 576 *e*, 925 *c*, 976 *b*, 978, 1010. Also p. 872 P.S. 1860).

§ 1058, *r*. In respect to diseases of the *serous tissues*, they are probably less influenced by the mercurials than of most other parts. Neither *pleurisy* nor *peritonitis* are very sensibly benefited, nor are they apt to be aggravated by full doses of Calomel, unless it be inflammation of the serous coat of the intestines; and here there is but little chance for other remedies until the disease has been broken down by loss of blood (§ 960 *f*, 995, 1005 *e*).—NOTE H p. 1117.

§ 1058, *s*. Next, as to the *kidneys*. These and the renal capsules have become *specialties* with many, who are apt to mistake what is merely

symptomatic for some positive disease of those organs. The urine is analyzed, and a variety of pathological conditions are detected in the results, or some remote symptom is associated along (§ 426, 427, 691, 905½ *b*, 960 *c*, *d*, 1029, 1032 *a*). Hospitals supply the bulk of disorganized conditions. Other affections of the kidneys, especially such as are acute, derive more or less benefit from the moderate use of Calomel; but Blue Pill is commonly to be preferred, particularly in *diabetes mellitus*.

§ 1058, *t*. Where inflammation of any of the tissues of the *eye* is complicated with gastric and hepatic disease, as is often the case, especially in epidemic ophthalmia, the occasional exhibition of Calomel, in a decisive dose, along with Jalap, or followed by Castor Oil, if necessary to a full cathartic effect, is generally very useful; and especially so if the cathartic have been preceded by general or local bloodletting.

§ 1058, *u*. Next to bloodletting, Calomel, in full doses, is the most important remedy for *apoplexy*, along with Jalap, &c. But there is great variety here. There are cases in which no cathartic is admissible, and others where none but Croton Oil will rouse the intestines. For the rest, I refer to § 990–990½.

§ 1058, *v*. Calomel, in one or more full doses, is indicated, generally, in *epilepsy*, if bloodletting be also necessary. But, if loss of blood be not required, Blue Pill is entirely preferable. Much will depend, in these respects, upon the condition of the abdominal organs. If there be much derangement here, a large blister over the epigastric region yields much relief, though these are cases which are often greatly benefited by Loss of Blood. A rigid attention to diet, and other natural habits, are the great preventive means. But a reliance is apt to be placed upon some fancied specific, and when the paroxysms come on the *symptom* is often in the ascendant (§ 163, 884, 887, 891½ *e*). I see, however, by a late Report of the Chairman of a "Committee on the effects of Bloodletting in Epilepsy, Convulsions, &c.," embraced in the able "Transactions of the Indiana State Medical Society," that a new view appears to be entertained of the pathology of Epilepsy, which brings the disease, theoretically and practically, under the prevailing Brunonian philosophy (§ 1068, *a*); and, as the document is brief, and is regarded by the Publishing Committee as a "Model Report," and, moreover, shows us what are the growing prospects of "Bloodletting," I shall quote it without abridgment:

"Having examined," says the Report, "the literature of the subject, I find that none of our recent Authorities have any confidence in Bloodletting as a remedy for Epilepsy, but, on the contrary, an opposite mode of treatment is advised, the disease being one of *debility* instead of plethora. The question being altogether a negative one, and unsuitable for a report, I wish to be discharged from farther duty."—TRANSACTIONS, &c., p. 8, 40, *Indianapolis*, May, 1857.—See p. 591, § 891½ *e*.

§ 1058, *w*. *Asthma* supplies another example of greatly modified conditions; and it is only in the congestive form in which either Calomel or Blue Pill are wanted. But nothing affords such prompt relief in congestive asthma as General Bloodletting (§ 891½, *f*).

§ 1058, *x*. As in epilepsy, asthma, and hysteria, so in *chorea*, the treatment is apt to be suggested by the prominent symptom, and the patient accordingly treated by antispasmodics. But they are rarely of any use, and generally injurious in these diseases, which are constantly supplying instances of the importance of addressing our remedies to the exact pathological conditions (§ 668, 672, 673, 675, 681 *c*, 685, 891½ *b*, *d*).

Cathartics, also, have been especially recommended by others for chorea, and so exclusively by some as to render the practice empirical. But no two successive cases are alike; one may be greatly benefited by repeated cathartics, and the next may admit of only their very moderate use, or not at all. But it is my main purpose now to express my opinion of the salutary effects of occasional doses of Calomel or Blue Pill in those cases where cathartics are indicated.

§ 1058, *y*. A full dose of Calomel, probably along with Jalap or Castor Oil, is generally useful in *delirium tremens*, as preliminary to the use of morphia; though opiates are inferior to small doses of tartarized antimony. If there be high arterial action, or much attendant disease of the abdominal organs, or any important local inflammation, Bloodletting should be premised in many of the cases. But this requires much good judgment. In a large proportion of cases this remedy is not wanted, and in many it would be seriously injurious. Where doubt exists, it should be avoided, and the main dependence placed upon the foregoing antiphlogistics, and perhaps a Blister to the nape of the neck. If Bloodletting be practised, the patient should be in a sitting posture, and its effects should be carefully observed while the blood is flowing from the arm. I bled a very athletic man, with a bounding pulse, florid skin, and furious delirium, to the extent of twelve ounces, from a large orifice, when syncope came on in an instant of time, and tumbled him from his chair. But it completely carried off the delirium, though there remained much abdominal disease to be subdued by other means, of which a dose of Calomel and Jalap was one (§ 662 *c*).—See NOTE p. 425.

In another case of a robust subject, which was complicated with intense pleurisy, I bled the patient pretty freely; but he got no relief from this or any other remedy. I advert to this instance, particularly, as simple pleurisy yields readily to an early abstraction of blood (§ 624).

§ 1058, *z*. In *puerperal fever*, Blue Pill, whatever may be the dose, is more or less useful for its local effects, and much preferable to Calomel, which is liable, in this disease, to irritate the abdominal organs injuriously (§ 1058, *f*). But a prompt and large abstraction of blood, as we have already abundantly seen, is the only reliable means (§ 1005, *b–g*).

The relative value of Calomel, Blue Pill, Tartarized Antimony, and Ipecacuanha, as gradual Alteratives in the Treatment of Inflammations and Fevers.

§ 1059. Much has been said in these Institutes of the foregoing remedies, as employed in small doses with a view to their gradually alterative effects, but mostly for the purpose of illustrating principles. They have been regarded also, with the same intention, as employed in their full cathartic or emetic doses; and it has been seen that, in whatever doses administered, they operate upon one common principle—that of altering or changing the pathological conditions. By that alterative virtue the profound action of Calomel as a cathartic, or of Tartarized Antimony, or Ipecacuanha, as an emetic, may, by a single blow, as it were, overthrow a fever, or pneumonia, or croup, &c., when the same diseases would subside only slowly under those minimum doses which may display no other remarkable effect than the substitution of healthy for morbid actions. But, however great may sometimes be the curative influences of the maximum doses, the *minimum* are by far the greater auxiliaries to Nature. Such is an abstract view; for, in either case, it may

be indispensable that other remedies should have prepared the way for their favorable operation, as bloodletting to secure their salutary, or to prevent their morbific, effects either as cathartics, or emetics, or gradual alteratives; or a preliminary cathartic to render useful the emetic or the slowly progressive alterative (§ 672, 867, 871, &c.).—NOTE EE.

To enable us to comprehend the better how these agents quietly remove, in small and repeated doses, profound conditions of disease, it should be considered how, also, they will sometimes overcome the same by a single powerful impression—how Calomel will then display its power as a cathartic and unlock the liver,* or, at another time, calm the whole gastric and intestinal tumult of the epidemic cholera—or yet again, in the same full dose, will rouse the irritability of the stomach from apparent torpor, and set in motion the whole mechanism of vomiting—besides numerous other potent influences which Calomel is capable of exerting in its higher doses. And turning next to the agents of emetic virtues, we may trace out their unperceived operation as gradual alteratives by considering what has been said of the emetic effects of Tartarized Antimony in § 902, *e–g*, and by a reference to that philosophy of the operation of all these agents, through reflex action of the nervous system, as variously set forth in this work, and a glance at which may be obtained by simply referring to § 150, 151, 228–233¾, 500, 506, 514, 516 *d*, No. 6, § 549–557, 841, 854, 857, 863 *d*, 873, 889 *b*, 892⅘ *g*, 902 *e–h*, 904 *bb*.

But before leaving this subject of the modus operandi of remedies I shall employ the constitutional influences of the mercurials in farther demonstration of the doctrine which I have propounded, that remedies of positive virtues contribute to the removal of disease by substituting for the more profoundly morbid other pathological conditions that subside spontaneously, and this whether the action be exerted directly upon the part affected, or upon distant parts through alterative influences of reflex nervous action. The principle was exemplified in all its local and constitutional aspects when speaking of the modus operandi of Counter-Irritants, the Seton, &c.; but the constitutional action of the mercurials supplies another apt illustration. That effect as displayed in the salivary glands and about the tissues of the mouth is strictly inflammatory. It also subsides spontaneously. But the disease for which the mercurial had been employed, especially if acute, will have probably disappeared long before the artificial inflammation. And so of pleurisy after the application of vesicants. Now, what should be inferred from these facts? Certainly that the mercurial had altered the condition of the parts that were primarily diseased more or less according to the manner in which it had altered the condition of the salivary glands and mouth—perhaps only less intensely—only changing the already morbid states to other conditions less profoundly morbid, and thus substituting a pathological state which will subside more immediately than the transitory one instituted in the salivary glands. This, too, is farther seen in the correspondence in the increased secretion of bile in hepatic diseases as induced by the transient or more profound effects of the mercurials and the increase of saliva incident to salivation. The same principle is shown by cantharides—externally or internally. The inflammation it induces in the skin or bladder subsides quickly, but before it shall have disappeared from the surface it may have removed a pneumonia or a pleurisy; and this result demonstrates, in itself, the de-

* See p. 839, § 1058 *b*, *note*.

pendence of the cure upon a reflected alterative nervous action upon the thoracic organs, which is as completely, but less intensely and transiently, morbific as when cantharides cures erysipelas by its direct application to the affected surface (§ 854–860, 891½ *g*, 893 *a*, *c–i*, *l*, 894–901, 905). And so of the constitutional action of the unguentum hydrargyri as applied to the skin (§ 827 *e*, 904 *c*, 1088 *b*). From these analogies we pass along the gradations that are supplied by cathartics and emetics till we reach the less appreciable ones as manifested by iodine, quinine, &c. (§ 892½ *c*, 893 *q*), and, taking along the acrids in § 1065 *a*, we find that a common modus operandi appertains to the whole.

Tartarized Antimony.—Ranks here after Blue Pill. Others would place it as the first of the alteratives, from its almost universal adaptation to fevers and inflammations, and its great curative power. But, though far more unexceptionably applicable to these affections than the mercurials, it will not, in like manner, suddenly arrest continued fever, or acute inflammations, and, although gradually succeeding where the mercurials may fail, the latter not unfrequently have the same advantage over the Antimonial. But this comparison holds more with Calomel than with Blue Pill. Again, the mercurials exert a profound influence upon chronic inflammations, of which Tartarized Antimony is far less capable, though sometimes greatly more so, as in chronic rheumatism. The proper rank of Tartarized Antimony is probably immediately after Calomel, as gradual alteratives (§ 516 *d*, no. 6, 904 *bb*).

Ipecacuanha.—*Dose*, gr. ¼ to gr. 1, once in four to six hours. The repetition of one grain oftener than once in four hours will, in a majority of cases, soon produce vomiting (§ 549–559, 841, 873 *a*). Ranks after Tartarized Antimony. Is adapted to all the inflammatory affections to which the antimonial is suited, but is much less efficient in most, though far more so in a few, as in dysentery, where Tartarized Antimony, indeed, is inadmissible. May be also employed in many irritable conditions of the alimentary canal in which the antimonial cannot. It is of comparatively little use in chronic inflammations, excepting of the lungs; and renders very little service in idiopathic fever. Its advantages in some cases of indigestion have procured for it a place among the tonics. But it has no shade of a tonic virtue, though it will sometimes bring about corresponding results by its peculiar alterative action (§ 890½, *d*).

JALAP.

§ 1060. In the work on *Materia Medica and Therapeutics*, I have given to Jalap in conformity with the results of general experience, the third rank among the cathartics. There is no other, excepting Calomel and Blue Pill, that is so powerfully alterative in inflammations and fevers, and none so safe in connection with the curative virtues which are required in the early stages of these affections, and it is an early stage of acute diseases to which I always refer. This comparative exemption from objection is rather remarkable, when it is considered that, like Scammony, the active principle resides considerably in a resinous substance, and that the resin of Jalap is an acrid cathartic. But this only shows us that we must consult the direct effects of remedial agents upon morbid conditions to ascertain their actual virtues as remedies (§ 5½ *a*, 675, 686, 837 *cc*, 854 *bb*, *c*, 904 *c*). All that is of any value in this respect has been the result of experimental observation—observation limited to effects upon diseased states of the body (§ 137, *d*). And what

a rebuke is this to the pretensions of Organic Chemistry! Doubtless, it is greatly owing to analogical conclusions from the apparent coincidence in the resinous principles of Jalap, Scammony, &c. (§ 1063), that many have considered Jalap as unsuited to the acute stages of inflammation and fever as the other resinous cathartics. But experience shows it otherwise.

In making this discrimination, however, in favour of Jalap, it must not be entertained that it will supersede the necessity of Bloodletting in acute inflammations of important parts, and in numerous cases of fever, especially of all the congestive varieties, or that all the favourable effects of Jalap, like those of other cathartics, will not be as often promoted by previous Bloodletting in these affections; though it may be less morbific without.—See NOTE FF p. 1135, as to *Yellow Fever*.

When acute inflammation affects the intestinal canal, neither Jalap or any other cathartic can be employed till the disease is essentially overcome by other remedies. But even in these conditions it will produce less injurious irritation than any other active cathartic, excepting Castor Oil; and it may be a good deal divested of its irritating effects by combining with it some proportion of Tartrate of Potash.

With the exception of the Saline and Mercurial, it is the effect of most cathartics, especially of such as are called Resinous, and of Rhubarb, and Senna, to excite the general circulation during their direct operation; and this particularly if acute inflammation or febrile excitement be present. But the usual effect of Jalap is the reverse, if any present arterial excitement be not very high, and the intestine be not in a morbidly irritable state. Under these circumstances, the action of the heart and bloodvessels diminishes in force and decreases in frequency during the direct action of Jalap, which, in respect to uniformity, is a remarkable property of this cathartic, though frequently witnessed of Castor Oil (§ 1057, *l*).

But Jalap is recommended in the early stages of acute inflammations and fevers, with the qualification already made, not only by its comparatively unirritating effects, and its depressing influence upon the organs of circulation, but by its direct alterative effects upon diseases of all parts, under appropriate circumstances. Indeed, its alterative action is not especially manifested in any one organ; but it appears to distribute its effects more equally than any other active purgative upon all parts that may be the seat of disease. So far, it is singularly adapted to idiopathic fever, and to inflammation of all parts, excepting of the intestines. The copious secretion which it determines from the intestinal mucous membrane, and quite freely from the liver, is, also, another recommendation of this remedy in the diseases under consideration (§ 143 *b*, *c*, 148, 163, 847 *g*, 863 *d*, *e*, 871, 889 *f*, *h*, *i*, *n*, 900, 902 *g*, *i*).

But Jalap is rarely given uncombined. It has not, as I have said, any remarkably greater effect upon one organ remote from the alimentary canal than upon another; but by combining other remedies with it, we may not only increase its own remedial influences, but produce special effects upon particular organs. For this purpose Calomel is generally the best adjunct. The effects of this combination, when appropriate, are well known to be remarkably great, each remedy contributing to the effects of the other, extending them with greater force than either, individually, to every organ of the body, and exerting a more special sway over the liver, breaking down disease wherever it exists in a direct man-

ner, and indirectly by influences that are exerted upon organs that are not diseased, through salutary sympathetic impressions reflected, through the nervous power, from these parts (as the skin for example) upon organs that are diseased (§ 143 *c*, 514 *h*, 674 *d*, 676, 889 *n*, 902 *g*, *m*).

This knowledge of the virtues of Jalap enables us to understand how it is that the addition of a grain or two of Ipecacuanha often improves its excellent qualities, especially when Calomel is also associated in the compound. Ipecacuanha is not less remarkably universal in its influences, though determining a more special action upon the skin, and upon the lungs in their inflammatory conditions (§ 2 *b*, 143 *c*, 148–151, 855, 895, 902 *f*), contra-stimulant, powerfully alterative, especially when thus appointed, and tributary to the purgative effect. When, therefore, brought into union with Jalap and Calomel in the dose of a grain or two, or, if a more powerful effect as a cathartic, depressant, and alterative be wanted (§ 227), then the Ipecacuanha in the dose of five or more grains forms a compound which is truly wonderful in its curative effects, so only the remedy be suited to the exigencies of the disease.

In all that I am now saying of the uses of cathartics, or, indeed, of any remedy, the remarks must not be taken in an abstract sense, but they suppose that other remedial agents have been already employed, whenever necessary, to place the disease in a proper condition for the remedy under consideration (§ 1058, *e*).

I have now stated the most useful combinations which Jalap is capable of forming with other remedies. The only other of much importance is its union with Tartrate of Potash (the bitartrate being often injurious by the excess of acid). This and Castor Oil are, in a general sense, the most useful adjuvants to Calomel, when the latter is administered in advance (§ 1057, *l*).

THE SALINE CATHARTICS.

§ 1061. In the Author's *Therapeutical Arrangement of Remedies* Castor Oil and Aloes follow successively after Jalap, and then appear five saline cathartics in the following order: 1. TARTRATE OF SODA AND POTASH. 2. SULPHATE OF MAGNESIA. 3. SULPHATE OF SODA. 4. PHOSPHATE OF SODA. 5. TARTRATE OF POTASH. This order of arrangement is intended, as throughout the whole plan, to indicate their supposed general relative usefulness. I will here remark that *Podophyllum* is placed as the fourth in order on account of its analogies to Jalap; but it should go down below the Juglans, as it is so fully superseded by Jalap. It yields, however, a useful extract, which Jalap does not.

The virtues of these saline cathartics are very analogous, yet each one is marked by certain peculiarities, but less individually characteristic than such as distinguish most of the other members of this family of medicines. In a general sense they are also distinguished from other cathartics, excepting Jalap, by often directly lessening any general arterial excitement which may exist at the time of their exhibition, and they have obtained, in consequence, the appellation of *Antiphlogistic Cathartics.* And yet their range of influence over severe forms of inflammation and fever is greatly less than that of the Mercurials, and Jalap, and Castor Oil. All these things illustrate § 500 *m*, 900, 902 *g*, *h*, 904 *a*.

But their adaptation to a vast range of mild fevers as ultimate remedies, and to inflammations of comparatively unimportant parts, gives to them the relative value which I have assigned them in the *Systematic*

Arrangement. But, in all inflammatory and irritable conditions of the intestines, these cathartics rarely fail of being injurious. Nor should they, as a general rule, be exhibited as a primary remedy in any disease of much importance; for, although they moderate general arterial excitement, they are but feebly alterative, and are liable, by an irritative action, to aggravate severe conditions of disease. Examples of this nature are often presented to our observation in cases where some one of these salts has been administered before summoning the attendance of a physician. These are particularly the cathartics which render much of their service by the secretion which they elicit from the intestinal mucous membrane (§ 863); but least of all do they reach the function of the liver.

It is seen, therefore, to be a peculiarity of these cathartics to irritate the intestinal mucous membrane without propagating an irritation to the general circulatory organs, even in their excited conditions, so long as they produce no injurious irritation of the intestines. On the contrary, if the disease be not intestinal, they will often greatly moderate arterial excitement during their direct operation; and it is this circumstance which has given them a factitious importance in the treatment of severe forms of disease. But the reduction of arterial action and of heat is mostly due to the free elaboration of intestinal fluids, and the absence of irritative virtues in the remedies. There is little or no alterative action exerted upon the immediate instruments of disease, where disease is at all profound. There is but little of that alterative reflected nervous influence instituted through the alimentary canal which constitutes the most valuable effect of remedial agents (§ 150–151, 163, 228, 526 *a*, 714, 716, 854 *c*, 859 *b*, 860, 870 *a*, *aa*, 902, 904 *a*). Although, therefore, the heat of the skin, and the excited state of the pulse, be moderated by the saline cathartics, it is often so only to return soon with equal or increased intensity. The remedy has not, in such cases, established salutary impressions; and, in this way, the days steal on, but each succeeding day bringing some ascendency of disease over what is gained by the illusory "cooling effects," as they are called, of the saline cathartics.

Those who depend upon their cooling effects are also apt to employ lemonade and oranges to aid in the cooling process; and, although these vegetable acids are set down in the books under the hypothetical denomination of *refrigerants* (§ 819, *a*, *Mottoes*), and are strongly recommended for the purpose of cooling down inflammations and fevers, it is not less certain that it is only an old relic of the humoral pathology, and that these acids have not the slightest tendency to diminish febrile or inflammatory action; but, on the contrary, they rarely fail to aggravate and prolong both. They produce an injurious irritation of the gastro-intestinal mucous membrane, thus inflicting a direct injury upon those organs through which we endeavour to convey relief to others.

Such, then, is the deceptive nature of the whole of this refrigerant system. Thousands are its victims; when one good Bloodletting, and a dose of some suitable cathartic, at the beginning, would effectually cool down the patient, and probably save the necessity of any farther active treatment in a great proportion of the cases. It is comparatively a small evil, however, with that which arises from an indiscriminate and excessive medication.

All this comes from the want of sound principles in physiology and pathology—the want of medical philosophy—and a consequent leaning upon the impracticable and visionary doctrines of the physical schools.

RHUBARB.

§ 1062. Rhubarb follows next in our *Therapeutical Arrangement*, and, doubtless, there are many who think it entitled to a higher rank. But, with all its reputation, its uses are comparatively circumscribed. It is not suited to any conditions of acute inflammation or fever, till, at least, they are far on the decline (§ 872, *a*); nor is it, at any time, a proper purgative when an active effect is required. Indeed, the real advantages of Rhubarb, as a cathartic, are limited almost to cases of diarrhœa unattended with intestinal inflammation, to indigestion, and to the stage of convalescence from most diseases, whether acute or chronic; and, I may also add, to scrofulous subjects when affected by indolent conditions of inflammation. I am speaking of it in its relations to disease as a cathartic, though it may exert simultaneously other very desirable effects. In smaller doses, other objects are in view, and they can have no participation in assigning the rank as a cathartic (§ 890, *b*).

Now, the reasons of this limitation are rendered obvious by considering the effects of Rhubarb upon certain diseased states of the body. When exhibited in fevers and acute inflammations, which make up the great amount of diseases, it aggravates them like stimulants and tonics; and it is also well known that it exerts the useful effects of tonics where these remedies are appropriate, as in dyspectic affections (§ 1065). Aloes, scammony, &c., increase them by irritant virtues.

Whilst, therefore, we thus learn that Rhubarb is not suited to febrile and inflammatory conditions of an active nature, the objections show us that it is well adapted to the periods of convalescence from those affections. Its mild tonic and cathartic virtues, as then manifested in small doses, give to it, under those circumstances, a high value as an auxiliary to Nature in her recuperative efforts. But in these cases, even, it should not be given uncombined (§ 872 *a*, 1064).

By its frequent effect in arresting diarrhœa, it is known to possess, also, what is called an astringent property. But of this I have already spoken (§ 890, *b*).

We have now seen that Rhubarb is cathartic, tonic, stimulant, and astringent; a combination of virtues which distinguishes it remarkably from all other cathartics. These united virtues impart to it a high value as a cathartic in certain conditions of disease, and a good substitute could not be supplied for it in those conditions. It enables us, also, to employ rhubarb most advantageously in many forms of disease where we do not desire its cathartic, but only its laxative effect that arises from small doses. In these small quantities, too, as a grain to five grains, the tonic effect of the remedy, which is then commonly desirable, is more strongly pronounced than in large doses.—NOTE EE p. 1133.

On account of these numerous virtues of Rhubarb, according, in part, to the quantity administered and the nature of the disease, I have arranged it not only among the cathartics, but among the alteratives, and tonics, and astringents. For the first of these purposes it is most useful when combined with Calomel, or Calcined Magnesia, or the Tartrate of Soda and Potash, or the Sulphate of Potash; as an alterative it is often useful, in small doses, in chronic inflammations, on account of its useful effect upon the alimentary canal and liver; as a tonic in dyspeptic cases, and in convalescence from acute diseases, when its action upon the liver, and its laxative effect, are also tributary to the cure; and, as an astrin-

gent, in cases of diarrhœa unattended by intestinal inflammation, and in large or small doses according to the precise nature of the disease.

Great mischief is done by the exhibition of Rhubarb in dysentery and scarlet fever. It is employed theoretically in the treatment of the former disease, on account of the astringent as well as cathartic virtue of this remedy, while the tonic and stimulating are completely neglected, as well as its pernicious effects (§ 892$\frac{4}{5}$, *g*).

SCAMMONY, ALOES, COLOCYNTH, SENNA, COLCHICUM.

§ 1062$\frac{1}{2}$. Three of the foregoing remedies, Scammony, Senna, and Colchicum, are produced here, not only for the purpose indicated in § 1057$\frac{1}{2}$, but to exemplify the manner in which remedial agents of powerful morbific virtues are commended to an indiscriminate use in those enlightened quarters where Bloodletting is nearly or altogether proscribed, and to thus institute a farther contrast between the abuse of the Materia Medica and the neglect or denunciation of the "*Remedium Principale*" (§ 819 *b*, 891 *c*, 954 *b*, 960 *a–h*, 1000, 1001, 1003, 1005–1006, 1007 *b*).

SCAMMONY, ALOES, AND COLOCYNTH.

§ 1063, *a*. The cathartics following Rhubarb (§ 1062) in our Therapeutical Arrangement are, respectively, Calcined Magnesia, Carbonate of Magnesia, Colocynth, and Scammony, the last of which, therefore, occupies the 15th rank as a cathartic of general usefulness, Aloes holding the 5th, or next after Castor Oil.

Scammony is a more irritating cathartic than Aloes or Colocynth, to which it is a good deal allied in its effects upon morbid conditions, although, unlike the latter it contains a large proportion of resin, which is the active principle (§ 1060). It operates with energy upon the whole intestinal canal, and exerts an alterative reflex nervous effect upon the liver, often inducing a redundant flow of bile in the inactive conditions of that organ. It is well suited, therefore, when properly combined, to habitual and obstinate constipation, where no intestinal inflammation is present. It is, for like reasons, and, like Aloes and Colocynth, curative of chronic diseases of organs situated remotely from the abdominal viscera, and which owe their origin to those abdominal affections of which I am speaking, or, having a different origin, become complicated with them (§ 905, *a*). These three remedies, indeed, are generally adapted to like conditions; though Aloes is much the best, and Colocynth is more alterative and remedial, and less irritating than Scammony. Each is pernicious in all inflammatory and irritable states of the intestinal canal, as well as injurious in all fevers, and in all acute inflammations of important organs. Nevertheless, Scammony, like Aloes and Colocynth, is more or less adapted to mild inflammations of the mucous tissue remote from the abdomen, as in catarrhal affections (§ 904 *a*).

§ 1063, *b*. An important error prevails in regard to the action of Scammony and Aloes upon the intestinal canal, it being supposed that they exert their effects (particularly Aloes) upon the lower tract of the large intestine. This conclusion has grown out of the irritation of the anus which often attends the operation of Aloes; but it is mostly due to the morbid bile which Aloes elicits from the liver. The Mercurials and Castor Oil have often the same effect in hepatic congestions, and it often occurs when no cathartic has been exhibited. Either for this reason, or because, perhaps, Aloes contains no resin, Pereira remarks,

in his great work on the *Materia Medica*, that "Aloes irritates less powerfully than Jalap"! The misapprehension has led to a great extent of malpractice, particularly to the administration of this cathartic in fevers and acute inflammations, and even in morbidly irritable states of the small intestines. Aloes is, also, for the same reason, in part, withheld from pregnant women, lest its supposed action upon the rectum should give rise to abortion, a result which was denied by Denman, while, also, Aloes is an emmenagogue of some pretensions. As to the latter fact, it restores menstruation in two principal ways: 1st, by its special sympathetic action upon the mucous tissue, remote from the intestine, in its morbidly susceptible conditions, as witnessed in catarrh and gonorrhœa; and, 2d, by its removal of indolent hepatic troubles and constipation, of which amenorrhœa is so often merely symptomatic.

The simple fact that Aloes affects readily and powerfully the hepatic function in its morbid states should leave no doubt of its special action upon the upper portion of the intestinal canal; but, that this is truly so may be rendered evident, and Pereira's comparison of Jalap and Aloes contradicted, by the following experiment, which may be readily tried by the advocates of Aloes and Scammony, bearing in mind that, when constitutional excitement ensues, or when allayed, by the operation of cathartics, it is mostly in consequence of their action upon the small intestine (§ 718, 889 *i*).

Let us, then, regard two patients, affected as nearly alike as may be with remittent fever. The skin of both is preternaturally warm, the pulse moderately full, and 100 beats in a minute. This is so far their corresponding state; the disease in its incipient stage, and there has been no treatment. Now, to one we will give 30 grains of Jalap, to the other 12 grains of Aloes; and let us take an observation of their symptoms at the time of the second alvine evacuation. The pulse of him who is purged by the Jalap has descended in frequency from 100 to 80 beats in a minute; while the Aloes has carried it up in the other to 120, being a difference of 40 beats. The skin of the former patient has become cool, and soft with an insensible perspiration. This patient is also placid, and feels himself relieved. On the contrary, the skin of the other is ardent and dry, his face flushed, his eyes wild, his head annoyed with pain, and his whole system in an agitated and harassing state. This is the test, and by this should we be governed both in practice and in theory. It illustrates also the principles in § 500 *m*, 863 *d*, 904 *a*, &c.

§ 1063, *c*. The objections which I have made to Scammony as an irritating cathartic lead me now to fulfil the purpose expressed in § 1062½, as I shall have occasion to do, also, when I come to the merits of those popular remedies, Senna and Colchicum. For this object I shall look into Pereira's elaborate and standard work upon the Materia Medica (as I have done on former occasions, § 891 *c*, 960 *a*), as one, among others quoted to the same effect, which represents the opinion of many.

"*Scammony*," says Pereira, "*is principally valuable as a smart purgative for children, on account of the smallness of the dose necessary to produce the effect, the slight taste, and the energy, yet safety, of its operation.*"

I shall not speculate upon the probable consequences of this eulogium upon one of the most irritating and drastic of the purgatives that are entitled to a reputable place in the Materia Medica, nor inquire how far it may have contributed to the success of homœopathy (§ 878). But I am entitled to assert, in the first place, that such is the great liability

of Scammony to produce constitutional irritation, and excite intestinal inflammation in Children, that it should never be exhibited to them under any circumstances (§ 576 *d*–577); and for the ordinary purpose of cathartics it is entirely unsuitable at any age.

Again: as to the attractive "*taste*" of medicines, which appears to be often of paramount consideration. Calomel, even, is recommended for Children upon this worse than mere empirical ground; and, of one of the most valuable remedies, and most appropriate for Children, Pereira says, that, "As a purgative for Children, Castor Oil has been used on account of its mildness; but its unpleasant *taste* is a *strong objection* to its use." Compare this with what he says of Tobacco at § 960, *a*. Neither is the "*smallness*" of a requisite dose to be for a moment weighed against the virtues of a better remedy.

SENNA.

§ 1064. The popularity of Senna as a domestic medicine, and the extensive use of it by the Profession, lead me to some comments which would not be otherwise made. If Bloodletting, in the treatment of inflammations and fevers, is to receive no quarter from those who build their hopes upon a more popular practice, or lose sight of pathology in the novelties and promises of Organic Chemistry, let us see to it that they do not escape without rebuke for their lavish use of the violent articles of the Materia Medica (§ 819, *b*).—NOTE H p. 1117.

Pereira, in his able work upon the Materia Medica, supplies the best authority as to the general estimation in which Senna is held. "Taken by the stomach," he says, "Senna acts as a sure and *safe* purgative;" and again he repeats, "It is a *very safe* purgative, and may be given to Children, Females, and Elderly persons *with great security*."

That Senna is a "sure purgative" is as true as the same affirmation by our Author of Scammony (§ 1063, *c*); but it is nearly as far as Scammony from being entitled to the same general commendation of being "very safe." On the contrary, in my judgment, there is no other cathartic, in the hands of Physicians, which has been more extensively injurious than Senna; and this being so, I shall indicate its bad qualities before speaking of its good.

In the first place, Senna is rarely capable of any very salutary effect upon inflammations, either acute or chronic, or upon fevers. By its irritative virtue, it excites the general circulation; and as it is profoundly irritating to the whole mucous tract of the bowels, it rarely fails to aggravate idiopathic fever, or to exert injurious reflex nervous influences upon any inflamed organs. We have already seen how Rhubarb is misapplied in this manner, especially in dysentery (§ 1062). But that remedy inflicts its injuries in active forms of inflammation and fever by its tonic and stimulating properties—Senna, by its irritating (§ 889, *a*). And here, by the way, it is apropos of the Author to whom we are now paying our respects, that he says of Rhubarb that, "Given at the *commencement* of disease, it is a very popular remedy; and though doubtless it is often employed *unnecessarily*, it *rarely if ever does harm*." True, he also says that "it is not fitted for inflammatory or febrile cases."

But, as to this Senna, it may be safely said, that it should never be employed but with a simple view to its purgative effect, and then only in constipated states of the bowels when unattended with any inflammation of those organs. The griping of Senna is proverbial; and Physicians

have vainly flattered themselves that this effect may be counteracted by uniting Manna, or the Saline Cathartics, or a purgative Tincture, or some carminative, like Coriander or Anise, with an infusion of Senna; nor does a moderated heat in its preparation lessen the evil. What, then, does that griping imply, considering its universality? Certainly, an excessive irritation of the intestinal mucous membrane, and such, too, as is very likely to result in disease of the intestines, if these organs be in a morbidly irritable state. If any disposition to inflammation be present in any one of the tissues of the intestines, the action of Senna will be very likely to develop an attack of that disease. If any venous congestion affect the liver, it will be aggravated by the irritating properties of Senna. And, as it regards inflammations of other parts, and idiopathic fever, it is very likely, as is known in the best experience, to send its morbific influences abroad from the abdominal organs over those affections. Among the worst and most common manifestations of this are the sad effects of Senna in the treatment of scarlet fever.

The objections to Senna grow out of its radical fault of possessing very little alterative virtue of a useful nature, and a great deal of a morbific (§ 854, *d*). But a difference in this respect obtains in different climates; which applies, also, more or less, to other irritating cathartics, and to Tartarized Antimony in *emetic* doses. In latitudes north of about 40° these remedies are better borne than in the more southern; the reason of which is, that in New York and South there either exist in most complaints, or there is a great tendency to, derangements of the abdominal viscera.

Having, therefore, so little to say in commendation of this notorious member of the Materia Medica, and having dwelt sufficiently long upon its demerits, it only remains to be added, that it is most salutary when it takes along some one of the meritorious neutral salts.

COLCHICUM.

§ 1065, *a*. The most obvious effect of Colchicum, in small and repeated doses, is that of irritating the intestinal mucous membrane, as evinced by a purgative effect. In larger doses it produces nausea, vomiting, and hyper-catharsis. Indeed, this remedy is commonly arranged with the cathartics, though it is rarely employed with the usual intentions of a purgative. I am quite satisfied, however, that it will not often afford much relief in gout or rheumatism (to which its uses are mostly restricted) till it produces some purgative or laxative effect. For this reason, particularly, I have given it a low rank among the Cathartics in the Therapeutical Arrangement of the Materia Medica. This effect, indeed, is what we are to carefully watch; since, when it begins, if the dose have been large, or the intestines unusually susceptible, the purging is liable to be excessive and injurious.

Various incidental results are stated by Authors as following the use of Colchicum, such as occasional sweating, occasional increase of the flow of urine, &c. But these are only contingencies to which almost all remedies may lead, under particular circumstances of disease, and are of very little importance in an abstract sense (§ 422 *b*, 863 *d*, *e*, 892¾). It is worthy of remark, however, that Colchicum often reduces the frequency of the pulse, though at other times it exerts an opposite effect. But the interesting fact relates to the diminished frequency, which has been taken hypothetically as a ground for the administration of Colchicum as a

remedy for all kinds of inflammation, and is one of the expedients that have been devised for getting rid of Bloodletting. This brings me to one of the objects set forth in § 1062½.

"*Mr. Haden*," says Pereira, "*was the first to direct attention to the advantages to be taken of this effect in the treatment of inflammatory diseases* (*ut cit.*, § 1063, *c*).—NOTE I p. 1118.

I know not to what extent this very limited view in Therapeutics may have prevailed; but it has been, probably, the occasion of an effort now making in the United States to substitute for Bloodletting that very violent agent the Veratrum Viride, which has been long known to lessen the frequency of the pulse by an acrid narcotic virtue which it possesses, and which belongs to some of the acrid cathartics. The whole of this practice appears to have been suggested by a similar error in respect to Digitalis, and by the attempts that have been made to substitute Tobacco and Aconite for Loss of Blood (§ 500 *m*, 826 *cc*, 893½, 960 *a*).

Neither Colchicum nor Veratrum exert any antiphlogistic effect excepting upon those specific forms of inflammation which constitute rheumatism and gout; and both of them will aggravate these diseases in their acute condition till they are effectually moderated by Bloodletting, Tartarized Antimony, or other direct Antiphlogistics. In that respect they are upon common ground with quinine in its relation to intermittent inflammation, and with iodine to the scrofulous. They are very remarkable exceptions to all the general antiphlogistic means which are alike adapted to the early stages of the specific and common forms of inflammation, and which are indispensable at that stage, as preliminary remedies, to the favorable action of the specific ones upon the special modifications of inflammation to which they are alone adapted (§ 662, 671, 892 *m*, *p*, 892½ *c*, *e*, *u*). More remarkable exceptions occur in guaiacum and other substances of allied virtues which are peculiarly suited to chronic rheumatism, while they aggravate any other form of inflammation. Nor is it an uninteresting fact, that all these things, Colchicum, Guaiacum, Veratrum, Asagræa, Delphinium, Xanthoxyllum, Aconite, Mezereon, Savin, are acrids (§ 892 *b*, 892½ *v*, 904 *a*).

§ 1065, *b*. These, however, are only strongly pronounced characteristics; for the critical observer will find the same distinctions prevailing in various degrees throughout the Materia Medica, and they show us that experience, and not theory, is, or should be, at the foundation of all our knowledge of the virtues of remedies (§ 2, *c*); and not only so, but that we can have no just apprehension of their relations to disease without a long series of trials in the endless variety of pathological conditions, their fluctuations, their localities and sympathetic influences, or as they may involve the universal body, according to the range of inquiry which pervades these Institutes; and when the student shall have examined its details and principles, and seeing that there is not a conflicting fact or induction, but that it is a perfectly consistent and harmonious whole (§ 1, *a*), let him interrogate himself as to whether he can summon a fact or a doctrine from Organic Chemistry that will disturb that relationship, or withstand its united force.

§ 1065, *c*. But, however this may be, so long as the Chemical doctrines are in the ascendant, we may not hope that experiments of the foregoing nature will cease to occupy the place of rational Medicine. Nay more; failing in these, and considering the unpopularity of antiphlogistic remedies and the acceptable nature of the invigorating, we

need not be surprised that the Chemical treatment of disease is so extensively governed by the Brunonian philosophy. Of that philosophy I have said something in these Institutes, and adduced an example of its prevalence in the British Army when Robert Jackson undertook to demonstrate its real merits (§ 621 *a*, 890½ *f*, 960 *a*, p. 717, § 569 *e*, 1006 *f*, 1068). But how little would this Reformer rely upon human efforts could he now read the brief paragraph which follows:

"*Costly Medicine.*—A London (Eng.) paper says: 'The consumption of wines in our public hospitals constitutes one of the heaviest items of their expenditure. The wine account at Guy's Hospital last year, £1083; the spirit account, £376—total, £1459 ($7295). At St. Thomas's, the wine account was £629; spirit account, £521—total, £1150; or £2609 ($13,045) in one year in the (two) borough hospitals alone.' "—BOSTON MED. AND SURG. JOURNAL, July 2, 1857, p. 448.—NOTE F p. 1114.

§ 1065, *d*. Again, as to Colchicum. This is also one of the many violent remedies that have been employed not only as a substitute for Bloodletting, but commended in doses at which Bloodletting revolts (§ 960, *a*, p. 717). Thus:

"In some experiments," says Pereira, *ut cit.* (made with Colchicum on a *healthy* individual by Dr. Lewins), "debility, a feeling of illness, and headache were experienced. This feeling of debility is not, however, to be referred to the evacuations produced, for, as Dr. Barlow has observed, the number of motions is sometimes considerable without any proportionate diminution of strength. I have known, says Dr. Barlow, even *twenty stools* occasioned by *a single dose* of Colchicum, the patient not complaining of the least debility."—NOTE G p. 1116. Also, p. 656.

Now here is something of which we have a right to complain. In the first place, that Dr. Barlow should isolate a case of this nature, and put it forth to show that we have nothing to fear from "twenty stools" by *a single dose* of this most violent substance; and, secondly, that Pereira should quote it for the same purpose, and in opposition, even, to Dr. Lewin's experiment upon a *healthy* individual.

Having done this mischief, Pereira ultimately relates instances of death from over-doses of this medicine, and remarks that, "in poisonous doses, Colchicum acts as a *powerful* poison." Now, to my apprehension, when "a single dose" of any "powerful poison" produces "twenty stools," it is verging very closely upon its poisonous effects; and whenever Colchicum may treat our patients in that reckless manner, we may fear, at least, some troublesome intestinal inflammation as a consequence. There never was, and never will be a patient purged twenty times by "a single dose" of any cathartic, without being the worse for the violence inflicted upon his intestines (§ 960, *a*, p. 717). There can be no topic more worthy of professional criticism.

But I have been actuated in this disquisition only by a sense of the importance of considering well how the violent agents of the Materia Medica are often commended to our rash and indiscriminate use; and in so doing, to show, also, how probable it is that the same inconsiderate view of the subject has led to protestations against the most important of all remedies in the treatment of inflammations.—NOTE H p. 1117.

§ 1065, *e*. There can be no doubt that Colchicum manifests a much greater control over gout than rheumatism; and, although this is generally conceded, all practitioners do not agree as to the extent of its influence. Some of the most able and accurate observers, such as Sir E.

Home, and Dr. Paris, pronounce it a *specific* for the disease; while others, like Sir C. Scudamore, consider it, at best, only a palliative. Indeed, Scudamore, in his treatise on the gout, is disposed to look upon Colchicum with great suspicion, believing that, although it be a present means of relief, it increases the tendency to a repetition of the paroxysms. He thinks, also, that it loses its remedial effects by frequent use, although considerable intervals intervene between the attacks. Very much, however, will depend upon the particular circumstances of the case when the remedy is exhibited. If given at the onset of acute gout without antecedent Bloodletting, or when the abdominal organs are in a morbid state, we may look for disappointment.

ON THE ACTION OF CHLOROFORM, AND ANALOGOUS AGENTS IN PRODUCING INSENSIBILITY WHEN INHALED.*

§ 1066, *a*. The general prevalence of the Chemical or other physical doctrines of life, and the consequent interpretation of Pathology and Therapeutics upon the same principles, has necessarily led to as extensive a revival of Humoralism, and, as one of its dicta, that the causes of disease, and the curative means, so far as the nature of things will admit, are absorbed into the circulating mass of blood, where they effect their results in the blood or the solids through some chemical process (§ 40–46, 350, 350½–350¾, 821 *c*, 828 *d*, 830, 837 *a*, 840, 893 *e*, 904 *b*, 905 *a*, 1034). All but Setons, Cold, Mental Emotions, &c., are carried to this account (see INDEXES); and even some of the soundest Physiologists in other respects maintain that the poison of the Viper, Hydrocyanic Acid, and the spirituous extract of Nux Vomica are absorbed when the last two destroy life in a second of time, notwithstanding, also, it is palpable that their fatal action must begin on the instant of their contact with the lungs or the mouth (§ 350½ *p*, 441 *f*, 487 *g*, *h*, 494, 826, 827, 828 *a–e*, 829, 904 *b*, &c.).

And so, to question the assumption that chloroform and analogous agents produce their effects only after being combined with the circulating mass of blood, according to Liebig's or some kindred hypothesis (§ 350½, *n*, *p*), is held to be an evidence of ignorance in Physiology, and unworthy a moment's consideration. But, before this doctrine can be sustained, the facts in the foregoing references, and a multitude of others contained in this Volume, must be disproved. True, the blood is said to be changed in its colour, but that would necessarily arise not only from the exclusion of atmospheric air, but from the morbific action of the anæsthetic through the ordinary laws of sympathy, and is upon the same ground as the supposed absorption of Carbonic Acid Gas (§ 419, 827 *b*). Again: some may have supposed that they have smelt those agents in the blood (§ 282). But the sense of smell is apt to be fallacious, especially when in pursuit of some particular odour or some favourite hypothesis, and it is difficult to contradict it. But this would prove nothing as to their mode of operating; since, especially, others have failed of detecting the odour of the most fragrant and fatal (§ 494, 827 *d*, 904 *b*, *c*). Moreover, the odour of chloroform and of sulphuric ether is very diffusive and impressive, so that if even a minute quantity of either substance entered the circulation, it should be detected without the aid of the imagination. A drop of ether will impregnate the air of a large room. We have had reports of alcohol having been thus observed, and they have been appropriated by the Chemist accordingly (§ 440 *bb*, No.

* I will not forego this opportunity of expressing my full conviction that the honor of this discovery, and of its first practical application, belongs to Dr. HORACE WELLS.

9, § 441 *c*, 1048–1049); nay more, of the blood burning like a flaming current as it issued from a vein, and even of the spontaneous combustion of inebriates.* (See all the reported cases in *Med. and Physiolog. Comm.*, vol. i., p. 576–581, where each one is shown to be without foundation.) But alcohol is not absorbed (LIEBIG, p. 172, § 350, no. 94).

The veins of different organs have been, also, found congested after respiring the Anæsthetics, but less frequently of the brain than of some other parts. But this, too, proves nothing of absorption; for the same is the case when Hydrocyanic Acid, and the spirituous extract of Nux Vomica, whether taken by the stomach, or applied to the mucous membrane of the eyes, or nose, or mouth of rabbits, destroy life in a second of time (p. 675, § 904 *b*, 494 *dd*, 826 *d*), or the virus of a snake in a minute (§ 828 *c*). And let these observations be taken in connection with Girtanner's experiments and those of others (§ 494 *b–dd*), and with the remarkable results from pricking the floor of the fourth cerebral ventricle (§ 1032 *d*) and with the respiration of ammonia, &c. (§ 827 *c*).

But the question is not whether Anæsthetics or Nitrous Oxide be absorbed, as very possibly they are more or less, but whether they produce their effects through the medium of the blood, or by reflex actions of the nervous system. (See § 284, 1088 *d*. This distinction is fully considered in various places. See INDEX II.)

As the whole of this ground, however, has been gone over extensively in these Institutes, it is mostly the purpose of the present Article to bring the question under the trial of facts embraced in the foregoing sections, and others to which they refer, along with our demonstrations of the nervous power and its laws of reflex action; though the subject might have been left to a single consideration, which appears to me to be conclusive against the doctrine of operation by absorption, and which I shall now address to the *Physiologist*.

§ 1066, *b*. In the first place, then, it is conceded that the blood is from one to two minutes, at least, in going the round of the circulation (§ 904, *b*). It should, therefore, occupy nearly that time after the respiration of the Anæsthetics is begun before insensibility takes place, which is equally true, also, of Hydrocyanic Acid and the extract of Nux Vomica (the latter of which is not volatile, § 494 *dd*, 826 *d*), which have been known to destroy animals in a second of time (§ 904, *b*). But this is not the specific fact to which I have adverted, though it should be taken in connection.

I say, then, if insensibility depend upon the absorption of the Anæsthetic agents there should be no necessity for their unceasing respiration, or quick repetition, to maintain their effects. The blood once charged, or however modified, should be capable of prolonging insensibility far beyond any thing that is observed in experience. But if, on the contrary, the effect arise from the influence of the agent upon the pulmonary mucous membrane, and be thence propagated by the nervous system, it would be quite likely to subside soon after atmospheric air is freely admitted to the lungs, as in § 481, *a–h*. Precisely the same peculiarities attend the respiration of the nitrous oxide gas (§ 827, *c*). The subject is quickly brought under its power, and his faculties are often fully restored in less than half a minute after atmospheric air is substituted. This is as true of *Amylene* as of chloroform and sulphuric ether. Thus, Dr. Orton, of Binghamton, N. Y., on administering ʒiij. of amylene, produced "*complete* insensibility in *about two minutes*." "Just as I was

* It has been lately reaffirmed by French chemists that alcohol, chloroform, &c., occur within the body, after their ordinary use, in a free state. See § 350, nos. 43, 94.—1861.

about to perform the surgical operation intended, the flexible tube with mouth-piece separated from the inhaler, and before I could adjust it my patient had completely recovered her usual sensation." The inhalation was repeated, and "the larger nail torn from the toe without the slightest uneasiness."* (*New York Journal of Med.*, Sept., 1857, p. 286.) Now, will any one believe, with his logical powers awake, that such a sudden transition, in either of the cases, could possibly happen were the phenomena owing to an incorporation of these substances with the circulating mass of blood! Give to the Chemical, or any other physical hypothesis, the greatest possible latitude of construction, or expound the results upon the vital theory, it is plain that when these agents are once circulating in the labyrinth of the organism, and in sufficient quantity to produce the astonishing momentary effects, they would continue to do so, in gradually diminishing degrees, until ample time should have elapsed for, at least, their elimination by the emunctories.

Again: the doctrine of absorption is contradicted by the necessity of diluting the anæsthetics with atmospheric air to prevent immediate death, which may happen so quickly as to preclude the hypothesis. This necessity of dilution supposes, therefore, the action of the Anæsthetics upon the nervous system of the lungs, and their transmitted influence over the entire organism by the reflex action of the nervous power; and this is farther seen in the fact that a greater amount would be absorbed during a long-continued respiration of the diluted agents than could happen when only momentarily exhibited in a concentrated state, and therefore death should as certainly follow in the former case. Moreover, all the earliest phenomena denote the direct action of the agents upon the lungs. Why are the effects so different when taken by the stomach?†

The whole philosophy, therefore, is perfectly explicable through what is known of the different susceptibilities of the various tissues, and in their various parts to the action of external and internal causes, and the wonderful attributes of the nervous system; and which enable us to comprehend the reason why the Anæsthetics so rarely affect the organs of organic life (§ 233¾, 422, 425 *d*, no. 7, 481 *a–h*, 487 *h*, 500 *g*, *m*, 891½ *g*, *k*, 893½, 1088 *c*, and INDEXES, Art. *Structure*, *Nervous Power*).

By the same philosophy we as readily comprehend the reason why the respiration of the fumes of Hyosciamus and of Opium establishes profound effects upon the whole organism, when no such result arises from smoking tobacco (§ 904 *b*). But what is very exact and comprehensive is the effect of ammonia when respired as a counter-poison for hydrocyanic acid. Here can be no relief from absorption, for hydrocyanate of ammonia is an active poison.

* I have introduced this case for the purpose, particularly, of referring to the remarkable fact that "the eyes of the patient were not closed at any time during the operation, but she seemed to amuse herself with an examination of the apparatus. She answered questions put to her with considerable promptness, and, in fact, conversed with my assistant during the period of insensibility," nor "was she aware that the nail had been removed when she recovered her sensibility. The pulse was but slightly accelerated."

There is no contradiction between this statement and that "complete insensibility" was effected. The latter refers to *common* sensibility, the source of pain; and the experiment illustrates admirably the distinction between *common* and *specific* sensibility (§ 197–201). The experiment, in thus showing the limitation of the anæsthetic influence to the nerves of common sensation, and in leaving the mind unaffected, as, also, the action of the heart, goes with our other facts in disproving operation by absorption.

The analysis which the experiment has supplied as to the modification of sensibility may be carried analogically to the organic properties, and be thus employed in corroborating our analysis of those properties (§ 170 *a*, 172, 175 *a*, *b*, 183–193, 205–221).

† That death is owing, as surmised by some, to the exclusion of atmospheric air, is contradicted by the phenomena, and by the failure of restoratives (§ 634).—See NOTE M p. 1120.

THE INFLUENCE OF THE MIND UPON THE ACTION OF REMEDIAL AGENTS.

§ 1067, *a.* Much has been said in this work upon the influence of the Mind in the production and cure of diseases; and it is now my purpose to extend this inquiry, very briefly, to the influences of the mind upon the action of physical agents, both as predisposing the body to the action of foreign morbific causes, and as modifying the operation of remedies. It will thus form an Appendix to what is said of the "General Philosophy of the Modus Operandi of Remedial Agents," or, rather, a grouping of many relative observations that are disseminated through the Institutes. (See INDEXES, Articles *Remedial Action*, *Remedies*, *Mental Emotions*, *Mind*, and *Will*.) The subject is practically important, and goes far in denoting the laws which govern the operation of physical agents upon the body, and in drawing a broad line of distinction between Chemistry and Physiology.

I say practically important; for who, indeed, of the Medical Profession has not suffered the experience of seeing the useful effects of remedies defeated by the despondency of his patient, or by some saddening emotion awakened by the indiscretion of friends, and often by a brief attention to business engagements, or by far simpler occupations of the mind? But there is great variety in these respects, according to the pathological conditions and the mental influences. The differences in results coincide, also, with such as are witnessed of physical agents; the same philosophy interprets the operation of both; and the same careful regulation of one is often as important as that of the other.

It is a matter of daily observation, in acute diseases, that the casual visits of relatives and friends, however much enjoyed by the sick, leave them for the worse; an effect entirely the reverse of what is witnessed of the same excitements in chronic forms of disease. But this corresponds with what is seen of the difference in the results of bodily exercise and tonics and stimulants in acute and chronic maladies. On the other hand, however, the subject of acute disease may be essentially benefited by the subdued cheerfulness of an habitual attendant. He may be, in like manner, seriously disturbed by listening to a page from a Romance, when, on the contrary, he would derive an advantage from an appropriate Chapter of the Bible; and yet both of these are remedial in chronic diseases. Nevertheless, there is a perfect consistency in the philosophy which attends the effects of those causes in the two cases—whether Nature be embarrassed by mental troubles and pleasurable excitements, or aided by placid cheerfulness and buoyant hope. The moody dyspeptic is invigorated in his digestion by every kind and degree of mental enjoyment, and his laxative and tonic medicines are sure to serve him best when his constipating melancholy is occasionally broken by hilarity of mind; while the subject of fever, though lacerated by exhilarating emotions, is started along by every smile of his Medical Attendant, and every remedy yields a boon to Nature under the influence of that smile, when a solemn countenance may make all the odds between recovery and death. In acute diseases, it is the tranquil emotions that do the service, while all of a joyful nature are scarcely less embarrassing to art than they are instrumental in the cure of chronic maladies. So nicely graduated is this principle in its operation, that it often happens that the subject of fever will make greater improvement in the hands of a common nurse than in those of a sympathizing friend. And yet there never

fell from the lips of the Medical Attendant a word of encouraging pity that did not tell favourably on his Castor Oil or his Narcotic.

It is, of course, impossible to analyze the precise influences of the mind upon the action of remedies in mitigating or aggravating disease. The principle is abundantly pronounced in morbific effects of the mind, that are independent of other causes, in embarrassing the favourable action of remedies; and it not unfrequently happens that the mental condition may baffle the best efforts of art, not only as a fundamental evil, but as crippling the curative means; while, on the other hand, when the same mental trouble is supplanted by happier thoughts, its baneful consequences not only yield as a spontaneous effect, but are hastened in their decline by the new mental influences. From these premises we may reason to all the transient and infinitely diversified affections of the mind that spring up in the progress of diseases which have their origin in physical causes alone, and calculate, with much exactness, the effect of one passion or another in aggravating or moderating disease, and how far they may embarrass or facilitate, through those modifying influences, the effects of remedial agents. But, to carry this analysis into practical effect in the treatment of acute diseases, there must be the same reference to their nature and fluctuations that is demanded for the right application of the Materia Medica, though it may be comparatively unimportant (§ 167 *f*, *note*, 476 *c*, 476½, 500 *k–p*, 509, 891½ *k*, 892¾ *b*, 951 *c*).

We have variously seen how the susceptibilities of organs to the action of physical agents are increased by morbid states, and it is exactly the same with mental emotions as with the physical causes; and with what prodigious power, especially in acute diseases, the latter may operate, can be readily inferred by considering how, in healthy states of the body, one passion, as fear, will agitate the voluntary muscles, depress the circulation, but impart a bounding motion to the heart, give rise to vomiting, open the floodgate of the kidneys, expel the contents of the bladder, protrude the eyeballs, drive the blood from the face, and bathe the skin with perspiration; or, how anger braces up the voluntary muscles, rouses a vehement circulation, &c.; or, how shame strikes at the capillaries of the face and injects them with blood; or, how marvellously love plays with its shafts; or, how hope ever gladdens the heart; or, how joy and anger may be instantly fatal.

So far, therefore, as the mind can have a bearing upon the action of remedies, it is by its direct influences upon the pathological states, through which it renders them more susceptible of either salutary or morbific impressions from physical agents, or renders them inoperative; while, also, it co-operates simultaneously, as an independent means of cure, or proves a direct morbific cause (§ 233⅘, 500 *k*, 647½, 903).

If the inquiry be extended to many of the familiar phenomena of the organic life of man, it will be seen that the mind is more or less interested in all the healthy functions; and it goes to supply more delicate illustrations of the influence of the spiritual part upon morbid states of the body. This, for example, is habitually seen in the improved appetite and more vigorous digestion, on occasions of festivity. Nor is it alone the unflinching manner in which the stomach meets its unwonted task (and much to the admiring wonder of the chemical philosopher), but it yearns for the multitudinous variety as the odour regales the nose, or the clattering of dishes delights the ear, and under the influence of which the mouth overflows with saliva. And now, if we reverse the

case, and suppose the Party, as soon as completing the repast, to be thrown into a paroxysm of fear of a few hours' duration by some impending catastrophe, it is certain that digestion would have made but little or no progress. Observe, again, how some remedies of active virtues are more or less governed in their effect upon comparatively healthy individuals by the varying conditions of the mind, as seen in the suspended or defeated operation of cathartics by any close attention to the daily affairs of life, and how, on the other hand, their effect is promoted by giving the attention to the anticipated results (§ 500 *e*, *nn*, 902 *l*).

§ 1067, *aa*. A well-marked example will illustrate the complex influences of physical agents and of the will and mental emotions when in simultaneous operation. Thus, when the voluntary muscles are slightly affected by nux vomica an aggravation of the spasm is often produced by any sudden alarm. A lady to whom I had administered a few very small doses of strychnia suffered some twitchings in the muscles of the legs when she walked in a careless manner, but was able to govern her limbs steadily by a careful effort of the will. In this condition she walked into Broadway, when, on being a little jolted by an uneven stone, she began to stagger, and, struck with alarm lest she should be considered intoxicated, she fell upon the pavement. This is not an uncommon example; and now for the rationale. That the spasmodic effects of nux vomica are owing to influences transmitted by the organic nerves of the gastro-mucous tissue to the cerebro-spinal axis, and a consequent development of the nervous influence and its reflection upon the voluntary muscles through cerebro-spinal nerves, needs no farther demonstration. The will was capable of surmounting that development by its own forcible excitation of the nervous power that gives rise to voluntary motion (§ 893½); but the sudden alarm not only arrested the operation of the will and allowed the tetanic its unrestrained action, but the alarm generated an exciting nervous influence which concurred powerfully with that of the physical cause. The philosophy as to the will is the same as when conia counteracts the spasmodic influence of strychnia, or as when coffee increases it (§ 891½ *g*, *k*, 984 *b*, *note*), only, in the case of the mind the excitation of the nervous influence is *direct*, in that of physical causes *reflex*. And so of the will and sea-sickness (§ 113–117, 222–233¾, 245, 266, 476 *e*, 500 *c*, 638½, 647½, 893, 893½, 1077).

§ 1067, *b*. Upon what principles, then, are we to interpret all the variety of effects which the different mental emotions display in the organic life of man? Simply, as already explained, by their operation through the medium of the nervous power, and the modifications which they bestow upon that power according to the nature of each passion. There is thus, throughout, a perfect coincidence between the operation of the mental and physical causes, since, whenever the latter give rise to effects beyond the direct seat of their operation, and thus bring the nervous power into action (§ 1039–1041, and *references* there), their resulting influences will, as in the case of the passions, depend upon their precise nature, and the special manner in which they modify the nervous power, as set forth in the foregoing sections (§ 227–232, 500 *k–p*, 503–505, 647½, 649 *b*, *c*, 657, 892 *b*, 892¾, 893 *e*, 894 *b*, 902 *g–l*).

§ 1067, *c*. From what has been now said of the coincidences between the effects of the mental emotions and remedial and morbific agents, and that they all operate upon a common principle (§ 854 *c*–857, 859 *b*–860, 894–905), and as the former are in perpetual operation, either for good

or for evil, it becomes evident that the Practitioner may be as intelligibly and as much interested in regulating the mental as the physical treatment of disease. The latter generally preponderates, often greatly, in importance; but occasions are constantly arising in which the former should take the lead, while it has at all times the advantage of being converted to the salutary effects of physical remedies.

Would our limits admit, we could draw upon the histories of lunacy for a vast amount of materials to illustrate the philosophy and practical importance of our subject. But all this will readily suggest itself to those who may study the phenomena of insanity in connection with the philosophy of the mind in its relations to organic life.

§ 1067, *d*. What we have now and hitherto seen of the precise correspondence between the effects of the passions and of physical agents in the organic life of man may be carried with the effect of the clearest demonstration in proof of the substantive, self-acting nature of the Soul (§ 1069–1077). This must be conceded by Philosophers of every school; and those who agree with the present writer in his construction of the operation of the nervous power will see how greatly the demonstration is extended by regarding that power as the medium through which physical agents exert their effects upon parts remote from the direct seat of their operation. Here we have a common exciting cause for the common phenomena. The mental emotions, in one case, bring the nervous power into action by their direct influence upon the great nervous centre, while physical causes, in the cases supposed, develop the power indirectly, and in all the cases each agent modifies the power according to its own special nature, and directs it in so complicated a manner, and according to an incalculable amount of contingent circumstances, through a labyrinth of nerves, as to form the most difficult problem in Physiology (§ 233¾, 475½, 500 *c–p*, 647½, 894, 902 *l*).

But to the mere practical man, who aspires beyond the walks of empiricism, the effect of the passions in the production and cure of disease, and their undeniable operation through the nervous power, supply a ready apprehension of those analogous problems which attend the operation of morbific and remedial agents of a physical nature, and a fruitful means for contesting with the Chemist the field of Physiology.*

HAVE DISEASES UNDERGONE CHANGES OF TYPE WITHIN THE LAST FORTY YEARS, OR HAVE NEW ONES APPEARED?

§ 1068, *a*. By change of type I mean that radical change which is supposed to justify the substitution of the stimulating for the antiphlogistic treatment of inflammatory and febrile diseases. In this acceptation I answer the interrogatory as it has been in all past time by every truly enlightened and impartial observer. John Brown, the great Antagonist of Nature, and who leads a host in his train, is in no respect an exception; for, whatever may have been his genius, he had very little practical knowledge, was intemperate in his habits, and the revolution which he achieved was prompted by animosity towards Cullen and other early friends. As it is important to understand the ground upon which this School originally stood, I shall introduce a brief sketch of its origin from the "*American Encyclopædia*." Thus:

"Brown was admitted, as an indigent scholar, to a gratuitous attendance on the lectures (Edinburgh), and obtained the patronage of Dr. Cullen, who employed him as a tutor in his own family. During this course

* See my work on the SOUL AND IRRITATIVE PRINCIPLE, edition 1871.

of study, he married, and set up a boarding-house, but failed, and became bankrupt. About this time, by a long course of meditation on the animal system, and the vigour of his own mind, directed by some reading, but seconded by little or no aid from practical observation, he elaborated a new theory of medicine. The result was, the publication of his *Elementa Medicinæ*, which he further explained in a course of private lectures. Brown scrupled at no means to push his doctrines. A new medical language was introduced; ideas totally at variance with former opinions were maintained; and the most virulent abuse of the regular Professors of the University was perseveringly uttered. At length, ruined in reputation, he repaired, in 1786, to London. Here he endeavoured to excite attention by his Observations on the Old Systems of Physic, but without success." — The day of success, however, was not long delayed. The *Elements of Medicine* had the advantage of being written in Latin; and as the simplicity of its doctrines, and the practice inculcated, were novel and fascinating, all Europe soon became ensnared by the charm (§ 621 *a*, 890½ *f*, 960 *a*, p. 717, 719, § 1006 *f*, 1065 *c*).

§ 1068, *b*. Under my own observation there has been no change in the character of diseases, with the simple exception that some forms have been less unyielding within the last twenty years than during the preceding twenty. But this qualification is mostly limited to the common forms of local venous congestions and congestive fevers (§ 757–785, 786–818, 961–970). These affections have yielded, during the latter period, to rather smaller abstractions of blood, and smaller doses of medicine, particularly cathartics. But precisely the same general mode of treatment has been indispensable to an early recovery, or to a complete removal of the disease, or to the preservation of life; while, on the contrary, the prevailing Brunonian treatment has been distinguished by its former disastrous effects (§ 1068, *a*). In proof of this, I need only advert to the excessive mortality which has attended the yellow fever within a few late years, and in the treatment of which the stimulating plan has been generally practised (INDEXES, article *Loss of Blood*). As an example of the mortality, under the stimulating method, it is stated in the able Report of a Committee of six Physicians on the "Yellow Fever at Norfolk, Virginia, in 1855," that

"The number of deaths was about 2000, or one fourth of the entire population remaining in the city. When we consider that half of this population was black, among whom there were few deaths, it seems probable that more than one third of all the whites attacked, died." — *Report*, &c., p. 38; Richmond, Virginia, 1857.* — NOTES F, FF, GG, II.

* In the same Report it is stated that the yellow fever "in its symptoms was much the same as all the great epidemics that have occurred either here or elsewhere" (p. 38). It was early in this epidemic that some physicians entertained the hope that the *Muriated Tincture of Iron* would prove a *specific* for the disease.

Here, also, we meet, among other important statements, with an observation of crushing weight to the doctrine of contagiousness of yellow fever. Thus:

"In no case that we have known or heard of was there the least reason to suspect that the disease was contagious. *Many hundreds* of our people, flying from the pestilence, *sickened and died* in the neighboring counties and cities, in hotels and private houses, in infirmaries and hospitals, under all possible varieties of place and circumstance, and yet we have not heard of a *single instance* in which it was ever alleged that the disease was communicated to the attendants or friends" (p. 38).

The foregoing appeared in the fourth edition of this work, and it is pleasant to incorporate in this sixth edition the following resolution, passed by the "American Quarantine and Sanitary Convention," at its fourth annual session, held June, 1860:

"*Resolved*, That the action of the last Convention on the question of the *non contagiousness* of yellow fever, to be found on page 16 of its Transactions, be and is hereby reaffirmed" — a question to have been settled upon the philosophical grounds embraced

As to the acute and chronic forms of inflammation, I have observed still less of the modifying effects of remote causes (§ 644–676, 710–756). In the acute form, as affecting all great organs, the same amount of bloodletting, the same cathartics, though in smaller doses, the same alterative antimonial treatment, &c., have been either necessary to life, or to an early and perfect recovery. In all these respects, pneumonia, pleurisy, inflammation of the brain, peritoneal inflammation of the intestines, puerperal peritonitis, rheumatism, &c., have remained without modification, or with the exception only that Cathartics require a more careful regulation of their doses (§ 857, &c.). In these conclusions I am also sustained by what I have learned of the histories of disease throughout the United States (§ 969 *d*, 1005 *l*, 1005½, 1006 *f*, *g*).

All this, however, is inferable, as it respects my own experience, from what appears in this work, which was published originally as late as the year 1847, and continued in repeated editions without modification; and I advert to the subject now, that I may not be misapprehended (§ 1004, 1005½). It may be also proper, in consideration of the preference which I have hitherto given to the experience of others as being of greater weight than my own, to repeat (§ 1025), that I have, doubtless, seen as much of the effects of Bloodletting in private practice as has been witnessed by any other Physician during my professional life, which extends over a period of more than forty years, while also I have been always unremittingly and actively engaged, up to the present time, in the practical duties of Medicine.—*Note* p. 763, Notes Ff p. 1135, Gg, Hh.*

§ 1068, *c*. Moreover, having adverted in this work to the treatment which I pursued in a case of inflammation affecting one of my own family (§ 992, *d*), and a case of remittent fever of which another member was the subject (§ 870, *aa*), I shall state briefly the practice which was pursued in one of simple pneumonia with which I was seized in March, 1847, as supplying evidences, at least, of my profound convictions upon all the questions before us. The first remedy adopted was the loss of blood to the extent of about two pounds. This was followed by five grains of Blue Pill, and in a few hours afterward by about two drachms of Castor Oil. Some ten hours after the Bloodletting, the symptoms having recurred, I was again bled to the extent of about 24 ounces. I now took at intervals of about four hours, half a grain of Ipecacuanha and two grains of the compound powder, the latter to allay the cough. Alterative doses of Tartarized Antimony were also employed at intervals of two or three hours, but not to the extent of producing nausea. About twelve hours after the last Bloodletting, the symptoms having again returned, though in a diminished degree, twelve large leeches were applied to my chest, and the bleeding maintained for several hours (§ 925, *a*). This was towards the decline of the day. The Alteratives were continued, and a Blue Pill of about five grains was taken. On the following morning, the symptoms having again increased, I desired my medical friend, Dr. James C. Bliss, to bleed me again. It was his opinion, however, that I might recover with the aid of the other means alone. I replied that I did not fancy the risk when I had so sure and safe a remedy in the farther loss of blood, and expressed a wish that he would "carry out upon myself the practice which I had inculcated in my medical writings, and which I taught my Medical Class." I had then in mind,

in § 650–653 *a*–*d*. The result shows the distinction between the instant application of sound principles and the tardy conclusions from complicated facts.

* Also Note Ggg p. 1151.

also, the experience which prompted the remarks just antecedently published in § 892⅘ *i*, 1006 *b*, *c*. I was accordingly bled to the extent of about 20 ounces, when the symptoms vanished entirely and permanently (§ 955, *b*).

On the ninth day after the last Bloodletting, when my medical friend called in the morning, he found me outside of the house, at my early morning exercise of sawing wood (§ 992, *b*, *c*). No other medicine was taken, and no blister was required. It should be said, also, that my digestion had been impaired for a long time antecedently, and that it became subsequently much improved (§ 1007, *b*).—NOTE HH p. 1138.

§ 1068, *d*. One case more, as farther illustrating the object of this Section. It may be interesting, also, on account of the usual fatality of the disease, and the embarrassing circumstances by which the case was surrounded; while it will go to show what have been the practical habits of the writer, and that he has inculcated nothing upon the subject of Bloodletting that has not been warranted by his own experience. The patient was one of our medical students, E. P. Johnson, M. D. of the Class of 1850–51. I found the fauces of an intense redness, tumefied, and attended with a complete inability to swallow. Any effort at deglutition was arrested at once by the suffering which it produced. There was great constitutional irritation, much restlessness, pulse rapid, hard, and small. Strength prostrated. No difficulty in respiration (§ 140, 525–530, 689 *l*, 718).

There was, at this time, a great deal of clamour in the Profession against Bloodletting under any circumstances; and as this case would be well known to the Class, I felt some regret that it had fallen into my hands, particularly as I apprehended a fatal issue, and that discredit would be brought upon the principal remedy upon which I saw that I must rely. Nevertheless, I sat the patient half erect in his bed, and bled him till syncope began to approach. The quantity of blood taken was about 40 ounces; an extent of the remedy which I practice only in severe forms of inflammation.

In a few minutes afterward the patient was able, after repeated and painful efforts, to swallow a dose of Calomel and Jalap—about 10 grains of the former and 20 of the latter. This operated within a few hours, but brought no relief. The throat remained of the same intense redness, and the patient could no longer swallow. Accordingly, on the same day, I bled him again to approaching syncope, when I abstracted about 32 ounces more of blood, the head and shoulders, according to my habitual practice, being elevated. Nothing more was done till the day following, when, finding the patient no better, I directed the application of twelve large Leeches to the anterior part of the neck. They executed their office well, and the bleeding was kept up for some four hours, but the patient was apparently worse in the evening. But, having done so much in so short a time, I concluded to await the issue of the last remedy till morning. Nothing could be swallowed, and the inflammation was too intense for a blister (§ 893, *p*). Curiosity was now on tiptoe about the bleeding, and the general merits of this remedy were to be judged by the issue of the case. I supposed, indeed, that it had been already condemned. Added to this, I felt an extreme degree of anxiety to save the life of my patient. So, on the following morning, one of the coldest in the Winter, I arose at four o'clock, and walked to the house of the patient, about a mile. What then happened I shall relate circumstantially,

as it may be of benefit to some others under similar exigencies, and, as I trust, for many generations to come.

The scene, when I entered the room, was in every respect of the most dispiriting nature. Johnson was apparently moribund. His mind was abolished, the fauces as red and tumid as ever, and a thread-like pulse running with almost countless rapidity. I stated to his nurse and classmate, the now Dr. Oliver, that the only remaining chance was from a farther abstraction of blood, but that the probability of immediate death was so great that it was inexpedient to risk any farther the reputation of this important remedy. That something, however, might appear, at least, to be done, I directed a large blister to be applied to the nape of the neck and shoulders, and left the patient with the expectation of finding him dead at my next visit.

No sooner, however, had I left the door of the house than I was beset by a painful consciousness that I had been in some measure deterred from a repetition of bloodletting by a fear that the patient might die under the operation, while, on the contrary, one more application of the remedy might save his life. In any event, it could but shorten it a little. This train of thought continued till I had walked some quarter of a mile on my return home, when I found myself almost unconsciously returning to carry out the practice which my judgment prompted.

I then stated to Oliver that I had returned for the purpose of giving to Johnson his last chance, and that if he died in my hands it was a sad responsibility to which all should be willing to submit, irrespectively of any consequences to themselves, or to practical medicine; that it was our duty to give to the patient the only remaining chance for life, even though the means employed might be likely to hasten a death which would be otherwise certain.

The head and shoulders of the patient were raised, and about twenty ounces of blood were abstracted (§ 973–980). The relief from the last bleeding was such that the patient could swallow water within an hour afterward; and from that time his convalescence went forward steadily and rapidly (§ 955 *b*, 994, 1000–1001, 1005).

The circumstances of the foregoing case, particularly the nature of the disease and attending symptoms, rather than the quantity of blood abstracted, impart to it its principal interest. In several cases of inflammation of the brain and lungs, where I have had the same successful conflict with disease, the bleedings have been much more numerous, especially in phrenitis, and the quantities of blood abstracted have averaged a greater amount at each application of the remedy. There has been, also, in the cases to which I refer, the same exigency for the last bleeding, aud the same apprehension that it might hasten death (§ 756 *b*).

P.S. 1860.—Finally, as nothing carries conviction like reliable statistics, and as no city has a more salubrious climate than New York, and to place its excess of mortality on the prevailing "stimulating plan," let us look at the statistics for January, February, March, and April, 1860, as obtained from the City Inspector's Report. During those four months there were 8283 deaths, of which the following are some of the startling details: Pneumonia, 602; Bronchitis (*pneumonia?*), 180; Croup, 312; Consumption, 1159; Scarlet Fever, 1000. Probably about 1 in 11 from *Pneumonia* of all the deaths (see *note*, p. 760).—Of London it is said by the Dublin *Medical Press*—"that the deaths from pneumonia in London number from 130 to 150 weekly, [about the same proportion as in the city of New York]; but that in Dublin a death from that disease is of rare occurrence."—(Boston *Med. and Surg. Journ.*, May 31, 1860.) The "stimulating plan" prevails in London, the lancet is used in Dublin.—See Notes F p. 1114, Mm 1141.

A *Note* which has stood in this place since 1860 is now incorporated with other remarks in Note Ggg p. 1151.

PHYSIOLOGY OF THE SOUL AND INSTINCT.

DEMONSTRATION OF THE SOUL.

§ 1069. In the year 1848 I published an ESSAY ON THE "SOUL AND INSTINCT, PHYSIOLOGICALLY DISTINGUISHED FROM MATERIALISM." As this is the only attempt made, so far as I am aware, to demonstrate the substantive existence of the Soul and Instinctive Principle upon physiological grounds, but, on the contrary, has been evaded (§ 350$\frac{3}{4}$, *gg*), and as the question is intimately connected with many of the great topics embraced in these Institutes, and forms an important subject in Physiology, I shall incorporate with them the essential parts of the demonstration contained in the Essay.*

§ 1070. The evidence turns wholly upon physiological facts; my essential premises are relative to the Nervous System, and are admitted by all. They are variously presented in this work, but must be now stated briefly to render the argument at once intelligible, and that it may appear a consistent whole. This involves, necessarily, a recapitulation of facts which have been hitherto presented in different parts of this work.

§ 1071. 1. The brain, or an equivalent ganglion, is the organ of intellectual, instinctive, and all perceptive functions (§ 197–199$\frac{1}{2}$, 455).

2. The spinal cord, and the nerves which depart from it, are, among other uses, the organs through which the Will transmits its influences to the voluntary muscles (§ 227, 233, 258, 473–475, 476 *c*, 500 *dd*).

3. The ganglionic or sympathetic nerve is designed, in part, to connect together, in harmonious action, the involuntary organs, or those upon which life essentially depends. It is also through this nerve, especially, that the passions display their effects (§ 96–108, 113–117, 126–130, 455, 523–524, and *references* there, and INDEX II., art. *Mental Emotions*).

4. The cerebro-spinal and sympathetic systems of nerves are intimately blended with each other, so that the brain, or its equivalent, is the great centre of both systems, and the spinal cord a less general centre, while the ganglia of the sympathetic nerve are now well ascertained to be local centres to that nerve. Of this character, also, are, doubtless, the semilunar and other plexuses, while, in very recent times, it is rendered probable that certain nerves are special centres of nervous influence (§ 1037, *a*); all of which, however, are more or less subordinate to the brain (§ 487 *g*, 497, 499 *a*, 516 *d*, No. 9, § 520–523, 524 *d*, No. 4, § 1038). Whatever, however, may be true of these local centres, it is of no importance to my demonstration.

In consequence of the foregoing union of the two systems of nerves, the cerebro-spinal system has certain organic influences upon the essential organs of life (§ 110–117). Physical irritation of the brain and spinal cord may be thus transmitted directly to the voluntary and involuntary organs (§ 473–494, 1039); and the Passions, but not the Will, by their direct action upon the brain, may readily affect these essential or involuntary organs through the sympathetic nerve (INDEX II., *Mental Emotions*).

The influence of irritations of the expanded extremities of the sympathetic nerve may be also transmitted to the voluntary organs through the circuit of this nerve and the great nervous centres, as seen in the

* Some things that I have said of Instinct lead me to state that the original edition was distributed extensively, and acknowledged in the literary journals in 1848. A REWRITTEN AND ENLARGED EDITION *will soon be published*—1870.

convulsions of children arising from dentition, intestinal irritation, &c. So, too, on the other hand, from the same intercommunication of the cerebro-spinal and sympathetic systems, irritations or other affections of the voluntary organs may be felt by the involuntary through influences transmitted by the sympathetic nerve (§ 454–475½, 500–524, 891½, *g*, *k*).

5. The familiar fact must be next stated, that the nerves are composed of two kinds, one of which transmits the influence of the Will and of the Passions, and the effects of other causes, from the nervous centres towards the circumference, while the other kind transmits impressions from the circumference to the nervous centres. The first of these two orders of nerves is concerned in the development of voluntary and many involuntary motions, and are hence called *excito-motory* nerves. The second order are nerves of sensation, or *sensitive* nerves, though the influences transmitted by them to the nervous centres are felt, in the natural state, only when propagated through the nerves which supply the organs of sense (§ 201–204, 227, 451–453, 462–475½, 500, 1037 *b*). It should be also remarked that, while some of the two orders of nerves are wholly or mostly of one kind or the other—either *excito-motory* or *sensitive*—a very large proportion of the nerves are composed of fibres of both orders, though perfectly distinct from each other in arrangement and function. This double order pervades the entire body, and has brought the physiology of the nervous system within the range of the most exact experiment, and has become the foundation of many important laws, which are as clearly ascertained as any in astronomy. The two orders of nerves, or fibres of compound nerves, never interchange their functions, one of them being always employed in transmitting impressions to the brain and spinal cord, and the other as purely centrifugal in its office (§ 466).

It is also important to understand that my demonstration is concerned particularly with the system of *excito-motory* nerves, both voluntary and involuntary, or those nerves or fibres of compound nerves which transmit influences from the brain towards the circumference. Nevertheless, many examples of nervous influence will be introduced, in which the other kind, or *sensitive* nerves, are equally engaged along with the *excito-motory*, as contributing to the demonstration. It may be said, too, that when the latter are alone concerned, as in all acts of the Will, or when the Passions operate, or when motions follow in the voluntary or involuntary organs from mechanical or other physical irritations of the nervous centres, the projection of the nervous influence is in a direct line from the central parts of the nervous system towards the circumference, and generally terminates there (§ 245); but that, when both orders of nerves are interested, the influences are circuitous. With these last, however, I shall be employed only for supplying illustrations in proof of the substantive existence of the Soul and Principle of Instinct, and of their *modus operandi* through the *excito-motory* nerves (§ 500 *dd*, *i*, *k*).

§ 1072, *a*. Having thus stated our anatomical and physiological premises, I shall next endeavour to render the demonstration of ready comprehension by the uninstructed in the physiology of the nervous system by stating many illustrations derived from the operation of physical causes to serve as parallel examples with the operation of the Soul and Instinctive Principle.

We have seen that influences may be transmitted from the brain and spinal cord towards the circumference by impressions made directly upon

those centres, as when they are irritated by mechanical or other agents, or when the Will or Passions operate (§ 1071, No. 4). We have seen, also, that impressions may be made upon these centres through irritations produced in distant organs, and then reflected from the nervous centres upon other distant parts, and even upon the parts from which the irritations proceeded originally (§ 512–524, 1071, Nos. 4, 5). This transmission of influences from remote parts to the nervous centres, and which is perpetually going forward between those centres and all other parts, in natural states of the body (§ 111–113, 455–458, 500), evinces the great and inscrutable susceptibility of the brain and spinal cord, and enables us the better to comprehend the action of an *Immaterial Substance* upon the brain, and its transmission of influences to all parts of the body. An immense proportion of the natural influences upon the great nervous centres (and they are unceasing and manifold beyond the compass of imagination) proceed from distant parts, and are circuitous in their ultimate destinations. They begin in the expanded extremities of the *sensitive* nerves, or *sensitive* fibres of compound nerves, in all parts, by which they are transmitted to the nervous centres, where they make their wonderful, and, as it were, infinitely complex but unfelt impressions, which are then reflected from those centres upon other parts through *excito-motory* nerves or the *motor fibres* of compound nerves (which are also called, in such cases, nerves of *reflexion*). The palpable exceptions to these reflected influences, and where the transmitted impressions terminate in the central parts of the nervous system, are normally confined to the impressions transmitted from the organs of special sense, as in seeing, smelling, &c., and when no mental emotions are excited (§ 194–204, 450–451).

We will now come to our examples of transmitted and reflected influences, which are clearly exhibited in respiration, in vomiting, in contractions of the iris, in the permanent contraction of the sphincter muscles, in spasms from teething, or from irritations of the intestines, &c.

In *breathing*, for instance, two principal nerves are concerned, and the *diaphragm* is the principal muscle which is moved. The *sensitive* fibres of the pneumogastric nerve, and more or less of the sympathetic, are the parts through which an impression, arising from want of atmospheric air, is transmitted to the nervous centres, which is then reflected upon the diaphragm through the *phrenic nerve*, and calls it into action. Now, the *phrenic nerve* is also the *excito-motory* nerve through which the *Will* operates upon the diaphragm in voluntary respiration. The other respiratory muscles have similar relations to the pneumogastric and to other excito-motory nerves, and the *Will* operates as readily upon the intercostal muscles as upon the diaphragm. But the diaphragm is conspicuously marked in this respect, and its importance is inferior only to that of the heart. For farther details relative to the coincidences between voluntary and involuntary respiration, and voluntary and involuntary coughing, &c., I would refer the reader to § 500, *c–nn;* and to § 902, *b–g*, for the physiology of vomiting, its various modes of production by physical causes, and the exact coincidences (as in involuntary and voluntary respiration) between their effect and vomiting brought on by *Mental Emotions.*

In *seeing*, there occurs the very complex example of the motions of the *iris*, which are entirely of an involuntary nature; while the iris stands in the same relation to perfectly distinct nerves as does the diaphragm. In the former case, the optic nerve not only conveys the impression to

the brain which is recognized by the mind, but it is also the sensitive nerve for the iris, by which the pupil is exactly adjusted to the degree of light, while, according to some, the excito-motory nerve of the iris goes from the ciliary branches of the lenticular ganglion through its communication with the third pair of cerebral nerves; but, according to other and later observations, "the cervical sympathetic is one of the motor nerves of the iris, and the spinal cord is the origin of the nerve fibres going from the sympathetic to the iris."* The brain is the bond of union in all the cases; but, for an obvious final cause, the iris, unlike the diaphragm, is withdrawn from the *Will* (§ 514, *k*). As the stimulus of light, however, is indispensable to the natural contraction of the iris, and is so far unobserved, it will be readily understood by the uninformed how a similar impression upon the pneumogastric nerve in the lungs is necessary to the involuntary motions of the diaphragm; and since the transmitted impressions to the brain excite no sensation, either in the foregoing cases, or in all the endless variety of reflex actions in which physical causes institute the movements, it becomes evident that it is no objection to the supposed action of an immaterial substance upon the brain that it is not *felt*.

We have now seen that the principle is exactly the same, whether impressions made *directly* upon the nervous centres give rise to motion in parts that are voluntary or involuntary (§ 1071, No. 4, and *references* there), or whether the impressions upon those centres be occasioned by influences transmitted to them from *remote parts*, and which, by reflexion, equally give rise to motions. But, in all the latter cases, the resulting motions are involuntary, as are all in the other cases excepting such as arise from the operation of the *Will*. But, in the case of the *direct* impressions, it is particularly important to remember that the motions which are produced by the *Passions* are essentially involuntary, and, therefore, so far exactly coincident with such as arise from irritating the brain mechanically (§ 1071, No. 4), and by our demonstration, the same, also, with any reflex movements that arise as the effect of impressions propagated from distant parts upon the nervous centres.

It may be finally added that the two nervous systems, and *both* orders of nerves, co-operate together in giving rise to motion in the organs of organic life, so far as organic actions *depend* upon the nervous system (§ 172, 176, 177, 226–233$\frac{3}{4}$, 1041); while only the brain and spinal cord and the *excito-motory* nerves are concerned in developing the motions which are brought about by the Mind, or the Instinctive Principle, or by Mechanical or other direct physical irritations of the brain. In ordinary respiration, for example, the *sensitive* fibres of the pneumogastric nerve are indispensable for the transmission of an exciting influence from the lungs to the nervous centres; but in *voluntary* respiration the pneumogastric nerve is not concerned, but only the *nervous centres* and the *excito-motory nerves* of the respiratory muscles. In the former case, the irritation of the nervous centres proceeds from the lungs, and therefore does not originate in the brain or spinal cord, and so of all reflex actions; in the latter case, those centres are directly irritated by the *Will*. In the former case, also, a cause *totally distinct*, and originally remote from the nervous centres, makes its impression upon them, and calls the nervous power into operation; while in the latter case, or that of voluntary res-

* Brown-Séquard remarks that "this fact is well established by Budge and Waller."—*Exp. Research.*, p. 10, 1853; also, § 1042.

piration, precisely the same nervous influence is brought into action, and through the same nervous channel, by the *Will*, and therefore, by parity of reason, by a cause as *distinct* from the brain and spinal cord as is the cause of the irritation in the former case. The first is true of all *involuntary motions* when the nervous centres are irritated by impressions propagated from other parts; and the last is true of all *voluntary* motions, and of all the *involuntary*, when the irritating cause is applied *immediately* to the centres.

These coincidences in results of irritations of the brain and spinal cord as brought about by irritations of parts remote from those centres with such as follow their direct irritations by *mechanical* causes, and the coincidences between the effects of indirect irritation of the nervous centres, as in involuntary respiration and vomiting by emetics, with the same effects of the mind in voluntary respiration and vomiting occasioned by disgust, and the coincidences, also, between the effects of mechanical irritations of the brain with such as ensue upon the operation of the mind and its passions, and a general concurrence of the coincidences, throughout, as to a manifest *cause* irritating the nervous centres, as well as a general coincidence in results, form the groundwork of this demonstration (227, 228, 233$\frac{4}{5}$, 475$\frac{1}{2}$, 476 *c*, 500 *c–p*, 647$\frac{1}{2}$, 844, 902 *l*, 1067 *aa*).

§ 1072, *b*. Let us now be critically understood, both here and in former places in this work, when speaking of the Passions as elements of the mind, and as producing involuntary effects. It certainly is not intended to be implied that they are not more or less associated with acts of intellection, and, perhaps, always brought into operation by some act of the Mind properly so called. This is also doubtless true of the Will, which appears to depend more or less upon the previous exercise of reflection, comparison, and judgment, in man, but moved into action in greater independence in animals—that is, instinctively. This remark may apply, also, to the Understanding (§ 241 *b*, 243). If, however, the Passions and the Will be the results of intellectual processes, the former, by their great variety and their peculiar operation in organic life, while the latter and all the higher faculties of the mind are excluded from that department of life, and the sameness of the Will, throughout, in principle and results, evince an individuality that renders them equivalent to elements or properties of the Soul and Instinctive Principle. They are as precise and peculiar in their phenomena as any admitted faculties, and their results are far more strongly pronounced. They must, therefore, be taken as equivalents, and as the only practical ground of discussion. All beyond is, at least, metaphysical (§ 243–246, 903, 1067).

But the question which is thus raised, in anticipation of any caviling, has no bearing upon our demonstration, nor upon any of the topics discussed in these Institutes. It is equally immaterial whether the Passions and the Will be distinct elements of the Soul and Instinctive Principle, acting independently, or summoned into operation by the higher faculties, or whether they be, respectively, the concurrent results of those faculties. In the latter case, they would be employed in a collective sense; and, as the results are the same as if they were distinct entities, and entirely different from other manifestations of Reason and Instinct, they are as properly designated by the specific names of Passions and Will, and the former resolved into Love, Hatred, Anger, &c., as any of the Faculties upon which they may depend are known by other names. They may be called mere Emotions; but still they would belong to mental processes, and that is enough for all the purposes that can bear any

relation to physiological inquiries, or to our present objects. It would be, indeed, equally to our purpose, were it conceded that the stimulus which gives rise to the Passions emanates from other organs than the brain, since they operate through the medium of the nervous system, are under the control of the mental faculties, and are palpably associated with them either as co-ordinate elements or as resulting emotions. The remote stimulus, upon this hypothesis, simply rouses the mind into action. The conclusions, therefore, which I shall have predicated of them can not be affected by any hypothesis of a metaphysical nature, nor by any supposed involutions of other organs with the brain (§ 167 *f*, 175 *b*, 183, 188 *a*, 227, 230, 232, 241–245, 476 *c*, 500 *f–p*, 902 *l*, 1067. Also INDEXES, article *Will*).—NOTE HH p. 1138.

Having thus disposed of this question to meet any subtleties of the speculative philosopher, I shall now interrogate the physiological facts as to the individuality of the Will as a property of the Soul and Instinct, when it will be found that it is in no respect the same complex emanation of either as the Passions. It is not obedient to any analogous laws, nor does it operate through the same mechanism as the Passions. It is distinguished from the Passions by the simplicity and precision of its results, by its great final cause, by its operation in animal life, and through the cerebro-spinal system, while the Passions operate mostly in organic life and through the sympathetic system. In all these respects the Will is on common ground with Judgment and Reflection, while it is the most important and uniform characteristic of the Instinctive Principle throughout the animal tribes (§ 476 *c*, 500 *h*).

§ 1073, *a*. It is allowed by all that some invisible, intangible principle exists in the Nervous System, commonly known as the *Nervous Power*, which is extensively concerned in the processes of animal organization; and I have endeavoured to show that this power is a vital agent, which is very variously brought into action either by physical or mental causes, and that when motion is produced by direct or indirect physical irritations of the brain, or by the Will or the Passions, it is in consequence of the development of this nervous power, and the direction of its influence upon the organic properties of the parts that are brought into motion. It operates equally in organic and animal life, but through very different channels and with very different results. It is most important in the organic life of animals, though its greatest final cause is relative to animal life. Its transmission to the former is through involuntary nerves, whether it be consequent on the operation of physical causes, or when the Passions disturb the organs in that department of life; and it is through the cerebro-spinal or voluntary nerves that the Will operates upon the organs of animal life, and when injuries of the brain or spinal cord, or when the Passions affect these organs. Such are the general facts (§ 1072, *a*). When the Will produces muscular motion, it is by developing the nervous power, and transmitting it to the voluntary muscles, when it stimulates the muscles, and brings them into action through their own inherent power. And just so of the Passions, and of physical causes. There is no wandering of the Will or of the Passions into the organs which they affect, as has been always vaguely supposed, no more than of physical agents when, on being applied to the nervous centres, they excite analogous motions (§ 233). It is also important to understand that the nervous power, by whatever cause developed, is liable to act with intensity upon the brain (§ 230, 509, 950, 1040). I have also

endeavoured to show that the nervous power is developed by the mind in all acts of intellection, and that there is then an associate action between this power, the brain, and the mind; though beyond the analogies supplied by the Will and the Passions this may be hypothetical (§ 234).

But all that is embraced in this Section, whether as to the nature of the nervous power, or its mode of development and action, or whether it have any existence, is unimportant to my demonstration (§ 234, *e–h*). It simply facilitates an understanding of the phenomena upon which the demonstration depends. (See INDEXES, Articles *Nervous Power*, *Sympathy*, *Remedial Action*, *Organic Life*, &c.).

§ 1073, *b*. I may say, also, that in the *Medical and Physiological Commentaries* I have endeavoured to show that the Nervous Power forms a bond of union between the Soul, the Principle of Instinct, and the Brain, and that this Principle is instrumental not only in the results of Sensation as set forth in the present work, but in the acts of Intellection. The phenomena of the Nervous Power in developing voluntary motion when the Will operates, and of the Passions in their demonstrations in Organic Life, supply many forcible evidences of the instrumentality which I assign to the Nervous Power in the concerted action between the Soul, the Principle of Instinct, and the Brain. (See INDEXES, Articles *Will* and *Mental Emotions*.)

§ 1074. From what has been now said of the ground of my reasoning, you begin to perceive the consequences which must logically follow. You begin to discern the force of the analogy between the effects of those elements of the mind (or emotions, if it be preferred, § 1072, *b*), the Will and the Passions, and of mechanical and other physical agents when applied to the brain. You see, already, that if the brain be influenced by SOMETHING when physical agents acting upon it give rise, in consequence, to motion in the voluntary muscles, and in the heart, bloodvessels, stomach, &c., so must it be equally influenced by *something*, and *that something* must be equally an exciting and analogous cause, when the *Will* gives rise to voluntary motion, or when the *Passions* affect the action of the heart, produce blushing, or excite vomiting, &c. From the exact identity of effects in the two cases, there must be an analogy among the causes and their modus operandi; and therefore the Soul and Principle of Instinct (of which the Will and the Passions are prominent characteristics) are as much distinct causes as are the mechanical irritants or other physical agents which determine the corresponding movements. I say, that such is your mental constitution you cannot resist this conclusion, however prone you may be to materialism. Here is an animal whose brain is shocked by a blow or irritated mechanically, and spasms follow in the voluntary muscles; and you see that the Will is even capable of imitating that convulsive affection. Here is another whose brain is irritated by the application of alcohol, and you see the heart beating more actively as a result; and here is a third whose heart is as quickly enfeebled in action by the application of tobacco to the brain, just as it is excited by joy and anger in the one case, or depressed by grief and fear in the other (§ 481 *a–h*, 487, &c.). You also witness the same spasms in the voluntary muscles from the operation of the Passions as arise from mechanical causes when affecting the brain (§ 486, 487 *g*). Consider, for example, a paroxysm of *hysteria*, where convulsions of the voluntary muscles are brought on by some *mental* irritation, and where they are exactly the same as when produced by disturbing the brain *mechanically*.

Consider, also, how greatly analogous are these mental paroxysms to the convulsions that proceed from teething and intestinal troubles; and how exactly alike are the voluntary and involuntary acts of respiration, one of them being determined by the direct action of the *Mind* upon the brain, and the involuntary act by an impression transmitted from the lungs to the brain. How precisely the same, also, the involuntary contraction of the *sphincter ani* and its contraction as effected by the Will, and where the same philosophy is concerned in respect to causation as in the voluntary and involuntary acts of respiration (§ 500 *o*, 514 *f*, *g*). Consider, too, among the inexhaustible examples, the variety of effects which result from the operation of an emetic, as set forth in § 902, *g*, and the same effects as produced by a blow upon the head—all consequent upon an irritation of the nervous centres—and then compare them with the *same* results which ensue when vomiting is produced by *disgust*, and even by its *recollection;* and compare many of these results with the effects of *Fear*—the bounding action of the heart, the small and rapid pulse, the half-suspended respiration, the pallor of the skin and the copious perspiration, the flood of urine, the hurried movements of the intestinal canal, the ghastly countenance and frightful eyeballs, the trembling of the voluntary muscles and the prostration of their power; or, compare the results of many physical causes, such as constipation of the bowels, with the effects of *Grief*, either so influencing the nervous centres as to undermine digestion, or so acting upon the brain as to overthrow the mental faculties; or consider how *Hope*, succeeding to Grief, will, like tonics, cathartics, shower-bath, change of climate, &c., influence the nervous centres in yet another manner so as to restore that digestion which Grief had impaired. And what makes the tears flow, when Grief, or Love, or Joy, or Anger, is in the ascendant, just as they do when snuff or other physical agents irritate the nose? Why does the mouth water at the sight of a bountiful feast, or on scenting its odour, or from its expectation alone, just as it will on chewing horseradish or tobacco? Why will the sight of a pill-box, or offensive odours, or startling or other unpleasant sounds, operate upon some after the manner of cathartics (§ 514 *m*, 844 *a*, 892¾ *b*, 944 *b*, 951 *c*)? It is palpable enough, that, in one series of the cases the effects are owing to some physical cause irritating the brain and spinal cord, and which is totally distinct and different from those nervous centres; and, can any one be so regardless of the plainest rule of philosophy as to suppose that the corresponding results, in the other series, are not equally due to some cause which is alike distinct and different from the nervous centres? All of them are the most familiar facts that engage our attention; but such as are relative to the mind have engaged us only as facts.

§ 1075, *a*. We now revert to our statement relative to the nervous power (§ 1073) in pursuit of a common exciting cause by which all the endless but analogous phenomena to which we have adverted are brought about. It is readily granted that the mechanical and other physical causes are not transmitted to the parts which they influence through the medium of the nervous system, and we must therefore look for some intermediate cause by which the remote effects are produced. It is of no importance to our present objects whether this cause be galvanism, or a nervous fluid, or nervous power, or a vibration of the nervous fibres, &c. (§ 184 *b*, 234 *a*); and, from the analogy in the effects of the Will and Passions, it is equally clear that these elements or emana-

tions of the Mind are not transmitted to the parts affected, but that they must operate through the same intermediate exciting cause as the physical agents. These unquestionable coincidences, therefore, not only place the external and internal primary causes upon common ground as substantive agents, but are demonstrative of their operation through some common cause appertaining to the nervous system. This is also farther sustained by the simplicity and consistency of Nature in her fundamental institutions, especially where the mechanism is the same, although there be great diversity in the remote causes and results.

Nor do I entertain any doubt, however much the physical school may look upon this question as an affair of "spiritualism" (§ 1034), that the facts, which are of such an endless variety, so distinctly pronounced, and so perpetually before us, will be universally allowed to establish the interpretation rendered in these Institutes of the *modus operandi* of the nervous power. There is not a phenomenon relative to the nervous system which the doctrine will not explain, nor is there one which can be consistently or intelligibly explained by any otner. (See INDEXES, Articles *Nervous Power*, *Sympathy*, *Remedial Agents*, *Will*, and *Mental Emotions*.)

It is also evident from my premises, that, if the movements which are excited by the action of physical causes upon the brain be only remotely due to those causes, and not to any primary change in the brain (which includes the transmitted as well as direct impressions), it must equally follow that the effects of the *Will* in developing voluntary motion, and of the *Passions* in modifying the action of the heart and bloodvessels, and other organs, cannot be due to any *original*, *primary changes* in the condition of the brain, but, of necessity, to some causes as distinct from the brain as are the physical. But, as this is the great point in *materialism*, and forms the chemical doctrine of intellection, let us admit that the remote effects brought about by physical impressions upon the brain are due to simply some physical change in the organ, and that, therefore, the corresponding manifestations of the Will and the Passions are equally owing to simply physical changes in the great nervous centre, it will still follow just as logically that there must be in the latter case as much an efficient cause for the cerebral changes as there is allowed to be in the former.

§ 1075, *b*. So far, then, the analogy is complete. But, in the case of the physical agents the causes are of a *passive* nature, and require other agencies to bring them into operation. How different, on the other hand, with the *Will* and the *Passions!* Here the causes are entirely *self-acting*, originating their own actions in the Sensorium Commune. This, in itself, establishes a radical distinction between the nature of the Soul and Instinctive Principle, and of all physical causes, and is utterly fatal to materialism. The *self-acting* nature of the Soul and of Instinct, and especially of the rational faculty, transcends greatly the Principle of Organic Life, which requires the operation of stimuli to rouse it and maintain it in action (§ 75, 136, 188½). Nay more, the *Will* and the *Passions* are among the most efficient causes in calling into action the Principle of Life; and being, in this respect, upon common ground with all *vital stimuli*, the materialist will see in this analogy an insuperable proof of the *substantive existence* and *self-acting* nature of the Soul, and how, also, the same analogy distinguishes the Soul completely from the Principle of Life, with which it has been confounded even by eminent Vitalists. The group of the facts is here so very comprehensive, and

so demonstrative of the two most important problems in intellectual and organic philosophy, that I pause in this manner upon the subject. But so far as action is immediately concerned in the two cases an analogy obtains, and we may reason upon that analogy from the *self-acting* Soul to the existence of an *active* Principle of Life upon which organic motions depend (§ 234, 1034). But, we shall seek in vain, throughout the wide range of Nature, for any direct similitude with the manifestations of Reason or of Instinct; though, if we pass the limits of Nature, we may discover in the results of Creative Energy that analogy with the Soul which shadows forth the Image of God (§ 234, *a–h*).

§ 1076, *a*. What has now been said is equally applicable to *materialism*, whether it regard the manifestations of mind as a *chemical* phenomenon, or as *elaborated* from the blood; and these are the only hypotheses which have any intelligible foundation. They must, therefore, be now considered more specifically.

The *chemical* supposes that all acts of intellection, all manifestations of the Will and the Passions, all the impulses of Conscience, and all Adoration of the Deity, are results of "*the chemical action which the elements of the food and the oxygen of the air mutually exercise on each other*" (§ 349 *e*, 500 *n*, 1054). This is the hypothesis of combustion. But enough has been said to show the impossibility of referring the phenomena to a chemical process without, at least, an attendant cause to institute the process. This, however, is farther examined at § 500, *nn*, *o*, to which I would refer the reader; and what will soon be said of the doctrine of *mental secretion* will be alike applicable, in principle, to the chemical hypothesis, and will cover the whole ground.

§ 1076, *b*. But there is a class of Philosophers who have endeavoured to render the chemical doctrine acceptable by admitting something like a Soul, which is supposed to act as a predisposing cause of that combustive process upon which the phenomena of Reason and Instinct are said to depend. But it may be readily seen that the hypothesis is illusory.

In the first place, the supposition of the dependence of thought, &c., upon any chemical process necessarily places the agency of the supposed principle, in its relation to the phenomena of Mind and of Instinct, upon exactly the same ground as the simple chemical hypothesis; for the results would still be chemical and nothing more. If oxygen unite with another element, and result in combustion, it takes place under a special law, and an exact chemical product ensues, which neither the Soul can alter, nor imagination affect. The only part which the Soul would take, according to any analogies borrowed from Chemistry, and which is necessarily the part supposed, would be that of exerting merely a predisposing affinity among the elements. This predisposing influence is meant to embrace whatever may be supposed to result from its action upon the doctrine of *catalysis* (§ 409 *j*, 350¾ *a–e*). In this only view of the subject, the chemical tendency of the Soul would no more react upon itself than that of *platinum*, and the only result would be (in chemical phraseology), a combustion of the elements of the brain, just as when hydrogen and oxygen gases are submitted to the catalytic action of the metal. And so of any other given chemical change. It always terminates in one way.

Whenever, therefore, oxygen unites with the phosphorus of the brain, according to the material doctrine of intellection, whether chemical or

chemico-spiritual, it can form no other compound than phosphorous or phosphoric acid, whatever the supposed activity of the combustion; or, if it unite with those other combustible elements of the organ, carbon and hydrogen, the resulting compounds must be carbonic acid in one case, and water in the other; or, at most, a special triple compound of those elements. An exciting, or predisposing, or any other agency of the Soul, even were the soul a material substance, would in no respect affect these results; and to imagine that the Soul enters into either combination, and is yet in perpetual operation, *per se*, would be a chemical absurdity. Whatever consideration, therefore, may be given to chemical processes thus instituted as the source of ideas, &c., it can be in no respect different from that which attributes them to one of an uncomplicated nature, whether the soul be immaterial or material.

The difficulty will be readily appreciated, both here and in regard to organic products, which are equally ascribed to a chemical process (for these doctrines are essentially alike), should it be attempted to call in the aid of the Soul, or the Principle of Life, in any of the manipulations of the Laboratory. They are so far on common ground; and, if the Soul can promote combustion in the brain, or in any way modify its results, or the Principle of Life subserve the chemical hypothesis of organic results (according to Liebig), they should be equally competent out of the body, so only they could be brought into external operation. But no imagination can surmise the possibility of applying them in a chemical manner, and, least of all, eliciting by the aid of the Soul the phenomena of mind from the most ingenious devices of Organic Chemistry. On the other hand, however, there is no difficulty in regarding the Soul as a *cause* acting through the vital constitution of an organ, and thus originating all the phenomena of mind; while, in so doing, we get rid of an unnecessary, as well as an unmeaning and mischievous multiplication of causes (§ 171–221).—See § 455 *a* as to final causes of the union of Soul and Brain.

The Chemico-Spiritualist is thus coerced to the alternative of ascribing all intellectual and instinctive functions to the immaterial principles in their co-operation with the vital constitution of the brain, or to deny the existence of those principles (whether immaterial or material), and throw himself exclusively upon the simple chemical rationale. If the doctrine stand, it must be upon its own merits, and not through any sophistry that may seem like a leaning towards the common faith of mankind—no gilding the material device—no concession to what may be considered the innocent but obstinate belief of the spiritual theorist, in the trust that he may finally discern the reality of his delusion.

Again, farther: the Organic Chemist maintains that all the processes of life are owing to the same combinations of oxygen with phosphorus, carbon, hydrogen, and nitrogen, as are supposed to give rise to intellection. The brain is thus placed on common ground with all other parts. Why, then, are there no manifestations of mind or instinct in the liver, intestines, or in the bones where phosphorus abounds? Or, turning to the accommodating Chemico-Spiritualist, I may ask, if the Soul or Instinct make all the difference as regards intellectual and instinctive manifestations, what makes the difference in respect to the corporeal phenomena? Nor is that all. If the brain be considered the source of intellection in its organic condition alone, how are facts treasured up, and ever present from childhood to decrepit age? As the brain, like all other parts, is constantly subject to renewals, the facts should go with the parts upon

which they are impressed, if the organ alone be their receptacle. Why, again, are the events of childhood fresh to the Octogenarian, when those of the day are speedily forgotten? Why may memory be trained with a special reference to particular subjects, and to a forgetfulness of others, or disciplined to a general compass of knowledge? Materialism must here be consistent and stand on its own philosophy. But the Soul, on the other hand, as also the Instinctive Principle, being one of an unchanging nature (as proved by these very facts), holds fast the treasury of knowledge, or the improvements it may gain (§ 180).

And here we come upon a demonstration which, were there no other objection, would be fatal to materialism in either of its shapes; for one hypothesis supposes that intellection, &c., is the result of the combustive process, and the other, of secretion. In either case, therefore, all ideas should be as evanescent as the processes themselves.

Finally, such as are disposed to follow the Author any farther upon this particular question will find in former parts of this work many suggestions which have a direct bearing upon it, as in § 350$\frac{3}{4}$ *e–n*, p. 180–192.

§ 1076, *c*. And now, as to the other branch of materialism, or that which regards the phenomena of mind, &c., as the products of *secretion*. This question has been incidentally discussed in these Institutes, but with other objects than are now contemplated. As it bears, however, as well upon the *chemical* as the functional doctrine, and as it is desirable to amplify the argument, and that it may appear as an integral part of the present demonstration, I shall introduce it here (§ 175, *c*).

I have there said that in former works I have presented certain facts which go to the conclusion that the Soul is a distinct, immaterial substance, and that the Instinctive Principle of animals is equally a distinct substance from the brain. I then proceeded to comment upon the main argument of the Materialists, drawn from analogy, that the mind, like the gastric juice, bile, &c., is only a product of the organic functions of the brain. I have there shown, also, that the supposed analogy is destitute of foundation. It might be sufficient, in proof of this, to simply say that the Mind and Instinct are wanting entirely in every known attribute of the products of other organs, and are *sui generis* in all their characteristics. But there are other more absolute characteristics which completely destroy the supposed analogy. What, for example, is the efficient cause of the production of bile, saliva, &c.? Certainly the blood, in connection with organic structure and organic actions—chemical, if you please. While these processes go on, bile, saliva, &c., are produced uninterruptedly; or, if arrested, it is from the failure of the organic processes. But it is just otherwise in respect to the Mind and the Instinctive Principle. All their manifestations are completely suspended during sleep, and often with great instantaneousness, or, to meet any sophistry about dreams, I might say half suspended; and yet the organic functions of the brain continue to move on as perfectly as those of the liver, the lungs, &c. Indeed, were any change of this nature to befal the brain, it would be particularly manifested by some consequent modification of all the organic actions, especially as those of the Mind and Instinct undergo complete suspension. The continuance of all the organic results proves that organic life is every where in perfect operation; while, by equality of reason, the suspension of all results in animal life proves that an agent, upon which these results depend, has ceased to operate. In one

case, organic functions must go on without interruption, and therefore the moving causes upon which they depend must be in perpetual action. In the other, it is ordained that the organs peculiar to the division of animal life shall have periodical repose (though only as it respects mere animal life), and, therefore, by parity of reason, their spring of action is constitutionally fitted for quiescence as well as action, and this, as it respects sleeping and waking, corresponds with the alternations of thinking and not thinking during the waking time. The various gradations in the suspension of mental and instinctive functions from their quiescence in the waking state to profound slumber concur, also, in this part of our demonstration. Nor is it at all important to our purpose whether there ever be a complete suspension of the intellectual or instinctive functions.

But again: suppose some change in the organic condition of the brain, as the cause of sleep (§ 500, *n*); what is it, I say, that so instantly reinstates its organic functions when we pass from the sleeping to the waking state? What arouses the organ to its wonted secretion of Mind, or what, in the other case, restores the combustive process? Certainly not the blood. Are there any analogies supplied by the liver, or by any other organ? Do you assume that some imaginary stimulus is propagated upon the brain from other organs? Then I ask what brings this into operation, and under such an infinite variety of unique circumstances? In what conceivable manner does it modify the organic functions of the brain so as to excite the secretion of Mind, or how, in the other case, does it start the combustive process? Do the functions of any other organ supply the slightest ground for such a conjecture? Will it interpret the reason why sleep is so prolonged in the habitually indolent, or, contrasted with this, why the laborious and exhausted student often sleeps less than others, whatever their occupation? Is it said that this is the result of habit, or of self-discipline? In either case it is an admission of a self-acting Principle, which brings itself and the brain under these influences, and therefore it is necessarily that Principle which rouses the brain from its state of suspended animal functions. It is a case, too, very strongly to our purpose, for it denotes a remarkable cultivation of the spiritual part, which enables it to spring into active operation from a dormant condition in habitually exhausted states of the body, while the brain, according to materialism, should resist all wakefulness till that organ, and all other parts, are fully recruited by repose (p. 329–332, § 500, *n–p*, *Liebig*). But the Materialist is not convinced by the difficulties attendant upon sleeping and waking; and again, therefore, I ask him, What is it that directs the special combustive or secreting process in all the acts of volition, in all the acts of intellection; or what brings them into operation? What are your conceptions of Creative Energy? Are not the results of Mind, however separated from Infinity, precisely analogous to those which are everywhere seen as the offspring of an Infinite Intelligence? But, if you admit a God, you will not reason from your debasing doctrines of the human mind to the Attributes of your Maker? And I ask the Materialist what answer he will make as to the condition of our Lord before His appearance upon the earth, and as He was "manifest in the flesh?" Was there no Spirit there? Nothing but material eliminations of Mind from the blood, or a conflagration of the elements of the brain? For so you must have it, and so it is *meant*, where the same mental phenomena are so interpreted in man. Nay more; so complete is the analogy between the acts of ratiocination and those of the Creator, as

seen in the humble designs which are devised and executed by man, and which, indeed, is all that we know of Him except from Revelation, it would unavoidably follow, upon the doctrines of materialism, that all the Designs of the Almighty Being were equally the results of chemical or organic processes! Or is this to be excluded from the pale of "*science*"?

The questions and arguments now propounded must be answered consistently, and in some conformity with the hypotheses drawn from analogy. If that can be done (this simple physiological requisite alone), then it must be conceded that the analogy is entitled to the gravest consideration. So, on the other hand, should the hypotheses fail in this indispensable requisite, materialism must stand convicted of sophistry, insincerity, and a leaning to infidelity.

Here we might bring our demonstration to a close as it respects the existence of the Soul, and its power of instituting actions in connection with the material fabric. But there may be some who may be inclined to follow us in a more extended inquiry than has now been presented, especially as the demonstration will continue to be predicated of admitted facts and principles, as set forth in these Institutes.

§ 1077. What will be presented in the present section is mostly a series of physiological examples which concur with the foregoing in enforcing the conclusions at which we have already arrived.

It has been seen, extensively, that impressions upon the nervous centres, by which the nervous influence is developed and determined with various effects upon distant parts, are all upon a par, in principle, whether they result from agents applied directly to the centres themselves, or be transmitted to them through the medium of parts remotely situated, or whether the Will and Passions make their demonstrations. Take some of the examples among the muscles which are both voluntary and involuntary. Let these be, again, the respiratory muscles, including those of the face. Now, their several movements are liable to numerous modifications, some of which are natural, as in sneezing, coughing, yawning, laughing, and others more or less morbid, as asthma, hiccough, &c. In all but two of these cases the movements depend upon the excitement of the nervous power through some sensitive nerve, which are generally the sensitive fibres of the pneumogastric, and the reflection of that power from the brain and spinal cord, through motor nerves, upon a part of or upon the whole of the respiratory muscles. In each process there is a special irritation of the nervous centres, and in each the nervous influence is brought into operation in a peculiar manner, and according to that manner is the nature of the movement. In *Asthma*, a stronger irritation is propagated from the lungs to the nervous centres, and a more intense motor excitement is reflected from the centres upon all the muscles of respiration (often including those of the face), than in ordinary breathing, and in some cases the Will comes to the aid of the irritation propagated from the lungs. Here, then, it is seen that a prompting of the *Mind* and the *physical causes* are brought into immediate *co-operation* in rousing the brain and spinal cord. The physical cause is insufficient to excite the requisite movements of the respiratory muscles, and therefore the Mind lends its assistance. Both act in perfect harmony together; nor can the slightest difference be observed in the results of either, excepting as the Mind acts with greater energy, and brings the respiratory muscles of the face into action.

Now, upon the physical hypotheses of intellection, what is it that

superadds to the respiratory movements, in the foregoing case, a cause perfectly distinct from such as naturally governs the process? If it be said, fluctuating conditions of the brain, what is the cause of those fluctuations? Why is there at one moment only a moderate degree of the supposed combustive or secretory process, and at the next a greatly increased amount of one or the other, and this requiring as much a cause as the excitement of the brain in the involuntary act? And here we may again advert to the sphincter muscles as supplying a parallel example.

Take another illustration — the acts of voluntary and involuntary *laughing*. When the feet or arm-pits are tickled, laughing follows irresistibly in many, as the effect of an irritation propagated to the nervous centres by sensitive nerves supplying the skin of those parts (§ 514 *d*, 649 *b*). The phenomena are the same as witnessed in ordinary laughing, where the Will and agreeable Emotions are the exciting causes. The former soon becomes painful, and then goes on in direct opposition to the Will. A man, for example, bound the limbs of his wife and tickled her feet till she died of laughing, just as some die suddenly of a strong mental emotion, "which," as Shakspeare says, "is as bad as die with tickling." And here I would ask the Materialist what other construction he can apply to the cases of sudden death from *joy* and *anger* than the powerful operation of some unseen cause upon the brain, and through that organ upon organic life? What other condition than a violent shock of the brain from a cause as distinct in its nature from the organ, as the *hammer* whose blow upon the head is fatal through precisely the same physiological influences? (§ 230, 455, 476½ *h*, 478, 479, 500 *f–nn*, 507–509, 634, 902 *l*, 951 *c*, *d*.)

A case precisely parallel in its physiological rationale with death from mental emotions (*last references*) occurs in syncope, when it arises from seeing or hearing something offensive, or from the sight of a lancet. Here the immediate cause, as in the case of death from joy or anger, is the instant and powerful determination of the nervous influence upon the brain, heart, stomach, &c. (§ 230, 479, 507–509, 634, 951). But there must be *something to develop* that nervous influence in the brain, and the common sense of every one assures him that it is a *conscious* agent which does the work. But, for the fullest illustration of this subject, let us analyze the physiological rationale of syncope as produced by offensive odours. Here the Mind may have but little participation in the prostration of the heart, &c., but the effect be mainly due to the physical impression propagated to the brain through the olfactory nerve, and perhaps, also, the nasal branches of the fifth pair (§ 514, *m*), which impression, in itself, develops greatly the nervous influence. But the Mind may also contribute to that development; for, if the odour were not perceived, no syncope might follow. Thus, again, are associated the physical and mental causes in producing a common effect, while in the case of the lancet it is purely a mental emotion which determines the paroxysm. But, in respect to the odour, the Mind generally endeavors to resist its effects, and as syncope may happen in spite of the effort, it is evident that the depressing influence may be mostly due to the direct action of the physical cause upon the brain, just as we shall soon see how a strong light acting upon another pure nerve of sensation may produce sneezing; but I think more the mental emotion (p. 79, *note*).

Let us now connect with the foregoing facts the syncope which follows

blows upon the head, and it will be seen, as plainly as we see that the physical blow upon the brain is the cause in one case and the odours in others, that the Mind inflicts the blow in the remaining series, or that of joy, anger, the lancet, &c. The physiological effects prove conclusively, both in their nature and coincidence, that one cause is as much an agent acting upon the brain as the other, and that both are equally distinct from the organ (§ 514 *m*, 844 *a*, 892$\frac{3}{4}$ *b*, 944 *b*, 951). In all the cases where the physiological effects are consequent upon mental processes the Mind and the effects stand in the same relation as do the physical causes and their effects in the other cases, and where the effects are precisely the same in both series. To suppose the absence of a cause in the former is a physiological absurdity, and to suppose any other primary cause than the Mind, as a *self-acting Agent*, is a greater absurdity. Nay more, the Mind, the brain, and the cerebro-spinal nerves are absolutely indispensable to all voluntary movements, however true it be that the power by which the movements are accomplished is implanted in the muscles (§ 258–267, &c.); while the motions of organs in organic life may go on without Mind, or brain, and even without cerebro-spinal nerves (§ 261, 264, 455 *a*, 461$\frac{1}{2}$ *a*, 478 *b*, 490, 1042).

I have said that in the several modified movements of the respiratory muscles mentioned at the beginning of this section, all but two depend upon irritations of the nervous centres propagated through sensitive nervous fibres from the lungs or other parts, and that, in all the cases, *the same excito-motory* nerves bring the muscles into action. The two exceptions are voluntary laughing and yawning. In the former case, the Mind, unlike involuntary laughing, rouses the brain without the intervention of any sensitive nerves, and determines the nervous influence directly upon the muscles of the face through the excito-motory nerves; which is also true of the bloodvessels of the face in blushing, and of the production of tears in weeping, though in the latter instances the nervous influence is propagated upon the face and gland through motor fibres of the sympathetic nerve.

In *ordinary* yawning, which is exactly a modified form of respiration, the Mind may have but little or no participation in the act, but it may depend alone upon a physical impression transmitted from the lungs to the nervous centres, along, perhaps, with a concurring sense of uneasiness propagated from the voluntary muscles; or, if the Mind participate, as in its efforts to relieve a sense of weariness, the physical and mental causes act in co-operation, just as happens in severe cases of asthma. At other times, a very different chain of causation may be observed, and where, also, the mental and physical causes appear to identify themselves, as it were, with each other, as in *sympathetic* yawning, where one yawns on seeing or hearing another yawn, or in talking about it; for, in one case, an irritation is propagated both to the brain and Mind through the optic nerve, and in the other case through the auditory nerve, and simultaneously the Mind conspires with the physical irritations in exciting the nervous influence, and directing it upon the muscles of respiration. But a paroxysm of yawning may be readily consequent upon simply *thinking* about it, as will probably be the case with many on reading this statement; when the reader will, doubtless, feel quite assured that his mind is as exclusively the cause in this instance, as the physical irritation commonly is in *ordinary* yawning.

Just so, too, in respect to offensive odours, when they produce *vomit-*

ing instead of *syncope*. In the former case the Mind may be more interested in the physiological effects than in the case of *syncope* from analogous odours; since the odours may be so far different in the two series that *disgust* is in operation in one, but not in the other. A rose may occasion syncope when just plucked from the bush, but vomiting only when in a decaying state. The Mind, therefore, in the case of vomiting, and the nervous influence, are brought into simultaneous operation by the transmitted impression, and the Mind then co-operates with the physical impression and occasions a farther development of the nervous power, and thus increases the intensity of that degree which is created by the physical impression. But the odours may produce either vomiting or syncope, as also purging, by their own independent influence, and in opposition to all resistance of the Mind; or, on the other hand, the Mind, as in breathing, yawning, and coughing, may be adequate to the entire effect, for it will produce vomiting by reflecting upon the former action of the odour, and which may have happened years antecedently. *Sympathetic* vomiting, on seeing or hearing another vomit, is mostly of this nature; but here, too, as in the case of the odours, the mind alone may determine an act of vomiting by simply reflecting upon a disgusting spectacle which had at a former time upset the stomach (§ 230–233$\frac{4}{5}$, 475$\frac{1}{2}$, 500 *c–p*, 514 *b*, *c*, *l*, *m*, 647$\frac{1}{2}$, 844, 892$\frac{3}{4}$, 902 *l*, 1066).

To render the foregoing readily intelligible to the student, farther explanations will be made. He has become sufficiently enlightened by the demonstration to see that, in all the examples, the Mind is necessarily a substantive agent, acting of itself upon the brain. The nervous influence which it develops, in the cases of vomiting, is exactly equivalent to that which arises from the action of an emetic upon the stomach. There is, however, one more link in the chain of causation in the former than the latter case; for when the Mind is the exciting cause, the nervous power is first projected upon the mucous coat of the stomach, where it irritates the organ after the manner of an emetic. This irritation is then reverberated, as in the case of the emetic, upon the nervous centre, and thence reflected upon the abdominal muscles, diaphragm, and muscular coat of the stomach, by which they are brought into spasmodic action. When vomiting is produced by *tickling the throat*, the Mind has no connection with the effects, but the physiology is so exactly coincident with that which is relative to the Mind, that it goes with the rest in showing how the Mind is necessarily a *substantive, self-acting* cause. The chain of causation is the same here as in the case of the Mind, only the first development of the nervous power is produced by the irritation of the throat (§ 233$\frac{3}{4}$, 500 *e–k*, 514 *b*, *c*, 894–896, 902 *e–g*).—NOTE D.

Whenever vomiting springs from disturbance, or disease, or any novel conditions of organs remote from the stomach and brain, the same chain of causation obtains as in irritating the throat; the point of departure being the affected part, and the nerves supplying it are the organs of transmission to the nervous centres. When the irritation, in these physical cases, is thus made upon those centres, it is exactly equivalent to the mental irritation when the Mind is the remote cause of vomiting, and the subsequent steps in the process are exactly the same in all the cases. The sickness and vomiting which spring from sailing, whirling, riding, &c., depend upon the same chain of influences. In these examples, the remote impressions which are propagated to the brain arise, in part, from mechanical effects upon different organs, and they are, in

part, exerted directly upon the brain itself. In these instances, however, the Mind often participates in developing the nervous influence, through some *emotion* that grows out of the physical influencee; as may be known from the fact that a strong determination of the *Will* to resist sea-sickness will often prevent its occurrence, especially the act of vomiting; while, on the other hand, if one has made up his mind to be sick, he will surely be so, though in the midst of a calm. In the former case, the development of the nervous influence by the motion of the vessel falls short of the intensity necessary to vomiting. And so of other analogous causes; and so, too, when offensive odours, disgusting sights, &c., operate, or when *memory* turns them again upon the stomach. In all such cases, and in various conditions of disease (§ 1067), the Mind, by resolving not to co-operate with the physical causes, or keeping down fear and other depressing emotions, may often yield no little protection to the stomach. In this counteracting influence of the Mind we have, also, another exemplification of its *substantive existence* and *self-acting* nature, as contrasted with its co-operation with the same physical causes in other cases (p. 78, § 167 *f*, *note*, 1067 *aa*).—NOTE D p. 1114.

In section 514, *l*, an example occurs, corresponding with the foregoing, in which the physiology of *sneezing* is shown when occasioned by the Sun's light impinging upon the retina. Here the circuit of nervous influence is very complex. And now observe how perfectly the Mind will do the same thing; since, by thinking intently upon a former paroxysm, the mind will develop the nervous influence by its own direct action upon the brain—will determine that influence upon the lining membrane of the nose, and give rise to the same irritation as the light of the Sun, or as in the case of snuff; when the subsequent steps become alike in the several examples. The only apparent difference, so far as effects are concerned, between the physical and mental causes, consists in the *self-acting* nature of the latter. The Mind, the nervous influence, and physical agents are all on a par in principle, as it respects their character of substantive causes in relation to effects (§ 234, *f*, 475½, 647½, 500 *k–p*).

Such are plain examples among a multitude of analogous ones. But we must consider others less obvious, that Materialism may not oppose us with specious problems in organic philosophy. It may be asked, for instance, How will you explain the movement of the limbs during sleep upon your doctrine? The ready answer is, exactly upon that doctrine, since the facts are of the same nature with those already stated. In these cases the act may be either voluntary or involuntary; but, throughout, it arises from some impression made upon the nervous centres. Sleep may not be so profound as to suspend entirely the action of the Will; or, in other cases, the motion is owing, remotely, to some impression propagated from the limbs to the nervous centres. These remote impressions arise from some constrained position, or analogous cause, and may not awaken perception, or call the Will into exercise; though, doubtless, in most cases the Will is roused into action. If involuntary, the phenomenon is then coincident, both as to cause and effect, with the motions of decapitated animals, as when, for example, a decapitated turtle draws up its leg on being pricked, or as a bird flutters or runs on striking off its head. Here the nervous influence proceeds, of course, from the spinal cord alone; and the example is another clear illustration of the substantive, self-acting nature of the Mind (§ 451, *c*, *d*).

Let us next suppose that the Materialist will demand of us an expla-

nation, upon our general facts, of the influences which are concerned in sleeping in the erect posture, which is common to many animals. The physiology of voluntary and involuntary respiration, and particularly of the action of the constrictor muscles, and the exact coincidences between the voluntary and involuntary acts in either case, supply, respectively, an answer to the interrogatory. It is evident, therefore, that in sleeping in the erect posture, the muscles are placed by the Will in a state of tension which determines upon them an unceasing nervous influence after the action of the Will is suspended, and in a manner analogous to that which holds the sphincter muscles in a state of permanent contraction (§ 514 *g*, 516 *d*, No. 6, § 902 *k*). Indeed, there is always, as in the case of the latter, a certain degree of involuntary nervous influence operating upon the voluntary muscles, by which their antagonism is balanced. This is shown by the division of nerves, as when those of one side of the face are divided, or paralyzed, the muscles lose their relation to those of the opposite side. Another example occurs in the wry-neck.

The same explanation is applicable to the contracted leg of the bird, in roosting.* The whole principle, in all its variety of manifestations, according to the nature of the animal and the uses of parts, has its foundation in consummate Design. The modifications in different species of animals correspond with those of Instinct, and are full of instruction to the contemplative mind. Their final cause belongs to the same inscrutable system of Designs as the varieties in Instinct itself; and, if we may not trace out the exact mechanism, or the remote causes in all the cases, there are a multitude of analogous facts which have been clearly ascertained, and which as clearly interpret the less demonstrable problems to every right thinking mind (§ 234, *a–h*). The route of the nervous influence among the organic viscera, and even among the voluntary muscles, is often eluding the knife of the anatomist (§ 233¾); and well may he sometimes despair of success, yet rest in the conviction that Nature operates by general laws, when he considers the fact that the Will determines its influence upon whatever voluntary part it chooses, isolating many intermediate nerves, or electing one only and far remote from its own seat of operation. And so he shall equally find it in organic life, where the Passions play their part, at one moment upon the heart, at another upon the skin, or kidneys, or genital organs, or raise the blush of modesty in the capillaries of the face, or strike us dead in an instant; and he may witness far greater demonstrations of the same principle in the operation of remedial agents (§ 852–888, 894–905).—NOTE A.

We draw to a close. If the discussion have been protracted, it has been due to the magnitude and the novelty of the subject. We might have rested the demonstration upon the operations of the Mind in its function of *willing* alone, were there a ready acquiescence in the logic of facts. Through these endless manifestations we almost see the *Thinking Being* enthroned upon the great centre of the nervous system, wielding at its inexpressible pleasure, and through the instrumentality of its organ, that amazing power which as far surpasses electricity in the compass and variety of phenomena, as the effulgence of Reason transcends the glimmerings of Instinct. The Will but commands (§ 1072, *b*), and Reason may be chained for hours to some abstract process, or tumultuous passion settles down in tranquil submission. With inconceivable rapidity of action it directs all the muscular movements which form the various feats of dexterity, the flight of animals, and the melody of song.

* See § 500 *dd*, and Article ROOSTING, *Index II.*

And let us consider, also, as we ponder upon these things, how exactly the mind graduates the force of every muscle which it brings into action, varying through every imaginable degree from the slightest touch to the death-struggle of the combatant (§ 234 *c–h*, 235).

Who, then, shall be so unjust to his Reason as to imagine that all this wonderful display of a single function of the Mind is the material product of chemical mutations of the brain, or of any organic function of that organ, and without a conceivable cause of the cerebral process!

DEMONSTRATION OF INSTINCT, AND ITS DISTINCTION FROM THE SOUL.*

§ 1078, *a*. In what I have said in the former part of this work of the distinct nature of the Soul and Instinctive Principle, and of their connection with the main central part of the nervous system, my remarks have referred to their immediate relations to the body, as established through the cerebro-spinal and ganglionic systems (§ 234 *f*, 241, 500, &c.). At section 500, *p*, the deductions are made from a variety of facts, though not altogether susceptible of direct proof. They involve a critical analysis of the various phenomena of which they are predicated, both in their relations to Reason and to the mere Principle of Instinct. But, however some acts of intellection in man may require the co-operation of the brain more than other mental processes, there can be no doubt that every act of the Mind and of Instinct is the result of an inscrutable concurrence between the *self-acting* cause and the organ over which it presides. It may be now said, also, that the brain is subservient to the Soul, independently of its relations to the body, in all its higher functions, while it manifests no such subserviency in animals; nor have I any doubt that all the facts warrant the conclusion that the nervous power is as well concerned in the functions of the higher faculties as it demonstrably is in the acts of the Will and the Passions. The instrumentality of the brain in the former case comes through the property of the Soul which is known as *perception*, and to which the senses are subordinate. The same property belongs, also, to animals; and so far as mere sensation is concerned, or as it may give rise to volition in its simple relation to animal life, the results are apparently the same in man and animals. But it goes no farther in animals, though in man Perception, as resulting from sensation, is the great fulcrum of Reason, and the fountain of intellectual knowledge. But that knowledge garnered up, every avenue to the Mind may be shut, and the harvest of facts remains, and may be now multiplied, cultivated, embellished by the exercise of Reason alone upon the organ through which the elementary knowledge had come. It may now summon a host of intellectual images, and render them tributary to those abstruse processes by which the laws of the Universe are scanned, and Mind itself analyzed and understood. This is abundantly manifested in the early displays of genius, where knowledge from external sources is just in its dawn. It is fatal to the doctrine of cerebral images.

But no such phenomena ever marked the highest cultivation of Instinct. It is all Instinct with animals, while this Principle is only feebly shadowed forth in man (§ 241). And this leads me to indicate the most fundamental distinction, in a physiological sense, between the Soul of man and the Instinct of animals; nor am I aware of any well-founded exception to the distinction which I make. Among the latter, the whole sum of instinctive processes is *limited exclusively to the wants and the uses of the body*. Whatever may be the fundamental cause, it is in complete operation at

* See *Note* at p. 873.

the moment of birth, when its dawning has scarcely begun in the human race (§ 241, *c*). It is as perfect and comprehensive in the Ant as in the Chimpanzee. Each species of animal, and all the individuals respectively, carry out an ordained plan of existence, and this is the compass of their knowledge. From that particular path Instinct never diverges. It has no higher aim in the brute than the mere perpetuity of organic life, and it never operates without manifesting effects, either active or passive, in *the mechanism of animal life*. That is its grand characteristic, and its broadest contradistinction from the Mind of man. It terminates there; and Reason, therefore, must prompt the conclusion that the Instinctive Principle perishes with the body. But how different with the Soul, which spans the sciences, rolls up its vast acquisitions through all generations, and sees in itself the "IMAGE of God." All its noblest functions have no relation whatever to the uses of the body. The untutored Savage has all the perfection of life that is enjoyed by a Newton, and greater instinct. He may become a Newton without a gain to his physical wants, but with some loss of his well-disciplined instinct. Here, in the exercise of Reason, all physiological analogies fail, while every impulse of Instinct demonstrates its subordination to physiological laws. When Reason operates, there is no participation of the nerves, as in the case of Instinct, no influences seen upon any part of the organism. We look upon its manifestations as emanating apparently from itself alone. And since there is nothing in the manifestations of the Will when it operates alone in the processes of Reason that denotes any influence upon the animal mechanism, as is always the case in animals, and since, also, that influence is strongly displayed in man when the action of the Will refers to the organs of volition, this distinction between its intellectual and physical functions corresponds exactly with my inductions in regard to the general constitution of the Soul, and the relation which it bears in other aspects to the body. Hence, we may again conclude incidentally that, by parity of reason as it respects the uses of Instinct, the Soul, which in its highest faculties is useless to the body, will continue to exist without the aid of organic life. And, if I may deviate, for a moment, from my physiological ground, to final causes of a moral nature, I would refer to the manifest design of animals for the human race, as a farther proof of their absolute extinction when those ends are fulfilled; and, on the other hand, to the noble and sublime objects of man in his no less obvious companionship with God, as equally conclusive of the perpetuity of his being.

Nevertheless, the analogies between the Soul and the Principle of Instinct are such (§ 241, *b*), that if one be a distinct, substantive, self-acting agent, so must be the other. But their great practical final causes, independently of our other facts, are broad, fundamental distinctions between them; nor have these distinctions, within my knowledge, been hitherto indicated. It is only, however, a display of the common law of analogies which prevails throughout organic nature. The coincidences and distinction between Reason and Instinct are far less remarkable than the corresponding analogies and distinctions which are supplied by organic life in its greatest extremes; for there is not a single organic function of a comprehensive nature performed by man that is not equally so by the lowest plant. With greater reason, therefore, should we argue the identity of Man and Plants than of the Soul and Instinct* (See *Note* p. 873).

* As an example of the assumptions and sophistry of those who reject the Soul, take

§ 1078, *b*. I am finally conducted to other and still more definite contradistinctions between the Soul and the Instinctive Principle, and where it will probably appear, also, that the brain co-operates less in the higher acts of intellection than has been commonly supposed. But the Mind, in all its functions, is not only more or less dependent upon its associate organ, but the influences which it is capable of exerting upon it in consequence, and thence upon the whole organism, are among the facts which form a broad distinction between the Soul and the Instinctive Principle. Nor can it be doubted that the full exercise of the Mental Faculties, as well as of Instinct, requires, in a general sense, a natural condition of the brain or its equivalent; and the greatest displays of the former are apt to be seen where the organ is developed beyond the common standard. To these general facts, however, there are important exceptions, several examples of which, as arising from organic disease and injuries, may be seen in *Medical and Physiological Commentaries*, vol. ii., p. 139, *note*. Equally true is it, also, that, from the co-operation of the Soul and the brain in the processes of Reason, excessive exercise of the Mind is felt injuriously in the organs of organic life, and too often permanently felt. The proper development of the brain is, also, arrested; and thus, in its turn, the Mind suffers a corresponding injury. Our general premises lead to this conclusion, and our primary schools confirm the principle in a lamentable amount of broken constitutions and smothered intellect. This, too, is one of our evidences of the substantive, self-acting nature of the Soul; and although the Instinctive Principle is equally self-acting, we here come upon the remarkable distinction that nothing like the foregoing has ever been witnessed from the severest discipline of Instinct. The Soul alone supplies these phenomena; and, from its incessant operation in undermining health, or disturbing the natural action of the organic viscera, it must be regarded as separating the Soul and Instinct widely from each other.—Note Hh p. 1138.

And this leads us to observe another and greater distinction; for, while the development of the Mental Faculties is retarded by overtasking the Mind in early life, just the contrary effect obtains in animals. By untiring zeal, and the lash of instruction, Instinct is often susceptible of influences in the *infancy* of animals, and *only then;* but here, again, it is just the reverse with Reason in the infancy of man. This distinction is also of a radical nature when compared with the improvements of Reason at later periods of life; for what has been supposed to be a

the following, from the "*Lectures on Physiology*," by the able and eminent Mr. Lawrence:

"If the intellectual phenomena of man require an immaterial principle superadded to the brain, we must equally concede it to those more rational animals which exhibit manifestations differing from some of the human family only in degree. If we grant it to these, we cannot refuse it to the next in order, and so on in succession to the whole series—to the oyster, the sea-anemone, the polypi, the microscopic animalcules. Is any one prepared to admit the existence of immaterial principles in all these cases? If not, he must equally reject it in man."

This argument is often staring us in the face, and it is quite time that it should be silenced, although "prepared to admit the existence of immaterial principles in all the cases." But, waiving the assumptions upon which the conclusions are founded, it is evident that the analogy fails as soon as we reach those animals which exhibit no rational manifestations. So the argument falls upon its own ground. Nor is that all; for, as in most cases where an author is at fault about principles, Mr. Lawrence contradicts himself. Thus, in another place he says that

"Although the external senses of brute animals *are not inferior to our own*, and though we *should allow some* of them to possess *a faint dawning* of comparison, reflection, and judgment, *it is certain that they are unable to form that association of ideas in which alone the essence of thought consists.*"

"*cultivation* of Instinct" is, in reality, no such thing, since it subserves no useful purpose, and manifests itself only under the special influences, respectively, by which the several impressions were originally produced. The "tricks," &c., of the animal, whenever there is a deviation from the natural operation of Instinct, require suggestions from the associate causes. Unlike the improvements of the Rational Faculty, the artificial conditions of Instinct do not operate without the excitements of the primary causes, or their equivalents, and then always in exact conformity with the nature of the external cause. In other words (for the distinction is important), Reason acts independently of remote causes; the artificial conditions of Instinct require the agency of such causes to bring them into renewed manifestations. In the former case the senses may not be interested; in the latter, impressions must always be made upon sense (as in seeing and hearing), and transmitted to the brain, or some equivalent nervous centre, when Instinct will operate in an automatic manner.* It is only a display of those low analogies between Instinct and the Soul to which I have referred. Imitation, in a higher sense, as seen in parrot-talking, belongs to the same principle. But in these cases it is more constitutional, on account of the natural prating of the bird. It thus becomes ingrafted upon its notes, and will therefore display itself as an offspring of nature, and as a matter of habit, and without any extraneous prompting. What is thus acquired from man by the parrot and magpie, and which has been supposed, even by Mr. Locke, to evince a Rational Faculty, is derived by other birds from other songsters, particularly by the American mocking-bird and cat-bird, who appropriate the notes of many other warblers. Now, there is nothing more in parrot-talking than in these last examples, and the latter is just as much an evidence of a rational faculty as the former. The examples go towards the illustration of our subject in showing how Instinct is adapted to the peculiarities of organization in different animals, while man, through his Rational Faculties, may *originate* an endless variety of vocal music, and construct languages for himself (§ 241, *b*).

§ 1078, *c*. Even the promptings of Instinct, which impel animals to search after food, whether for present or future use, have their origin in present sensations. What is prospective in this respect is just as impulsive as migration, and as little allied to the course of Reason. The same physiological influences of hunger, in regard to immediate wants, operate in the infancy of man, though with none of that discrimination which distinguishes the infant animal; for the human infant will as readily suck at all things else as at the breast. Its apparent instinctive impulses go no farther than the movement of the mouth; and that is *all* the display of instinct it evinces, unless farther shown by its cries when hunger is unappeased.

Again: as soon as Reason obtains its development, it displays an endless variety of inventions for the sustenance of life, which are wholly irrespective of associations with the original physiological incitements, but which must be forever a recurring cause to the animal. Whatever similitude may seem to exist between the acts of Reason and the acts of Instinct in procuring food, or in providing for the future, organic influences are interested in the latter as often as hunger returns; and, so far as the processes are dependent in animals upon the inscrutable constitution of Instinct, they are contradistinguished from all the analogous manifestations in man by their undeviating uniformity in animals, and ac-

* Rarey's system of *horse-taming* is a comprehensive illustration of the principle. All horses yield at once, and alike, to the foot-strap, as would a machine.—1861.

cording, also, to the species of animals, while, also, all the individuals of a species pursue a common and uniform way. Thus, many species lay wait to entrap their food, and although variously according to the nature of the species, all the individuals of a species act exactly in a certain way, while others pursue a different course, and neither takes forecast beyond the present sensation of hunger; while in some species which subsist on vegetable food, the principle operates seemingly after the sagacious manner of Reason in providing for their future wants.

§ 1078, *d.* And here we come upon another, and very broad distinction between the Soul and Instinctive Principle; for, as admitted by all, the greater the development of the brain in man, so, in a general sense, are the manifestations of Reason, and therefore a forecast in animals in laying up food, if at all allied to Reason, should predominate in those which have the greatest amount of brain; and here, if in any respect, there should be the greatest display of Reason. But it is just otherwise with all the superior animals, who take no thought for the morrow, what they shall eat; while in the bee and ant, where there are only ganglia for the nervous centres, there is an anticipation of the future in providing for the young which surpasses any thing known of the human race. What variety, too, in the structures which they rear for their progeny, according to the particular species in each genus, but always the same with each species. And then the food—just as methodically of a precise kind as the act of providing it. The whole history of the instinctive acts of the elephant or the lion may be written in an hour; but Huber found a good-sized book necessary for the amazing operations of the common honey-bee. He described the doings of a hive, and that description tells the precise history of all past and of all future hives. The diversified acts of this insect, and according as it may be queen, male, or drone, seem like the complex movements of some elaborate machinery, which, when wound up, runs on in one precise way till it runs down. And still more estranged from Reason, and utterly beyond its grasp, is the return of the bee to its hive through miles of trackless air, and the unerring flight of the carrier pigeon; nor are any of the higher animals capable of this amazing achievement, which, also, grows immediately out of the physiological arrangements for acquiring food.

§ 1078, *e.* The correspondence between the peculiarities of Instinct and the mechanism in animal and organic life is so remarkably full and perfect in its design, and so unlike any of the manifestations of the Human Mind in their connection with the organs and functions of either division of life, that a glance at the former will contribute farther aid in distinguishing the Soul from the Instinctive Principle, and in proving the absolute existence of Instinct as a distinct essence of the brute creation. If we may any where detect the Rational Faculty among animals, it should be found in the phenomena that are relative to their means and modes of subsistence.

Now it will be found that, in every species of animal, the promptings of Instinct in the pursuit of food have a direct relation to the peculiarities that exist in the organization of the stomach, and the modifications of the special endowments of the gastric juice in each of the species (as set forth in section 353), by which one species is enabled to convert flesh, another nuts, another hay, &c., into one homogeneous substance called chyme, and which, from man to the lowest tribes of warm-blooded animals, at least, is apparently alike in all, whatever the nature and the

variety of the food. But the agreement between man and animals is limited to that result in its connection with the digestive apparatus, and as it relates to the maintenance of organic life. What is true of the precise adaptations of Instinct to the organic conditions, and its invariable operation in one way, according to the nature of the animal, is in no way true of the Human Mind; for the latter operates, in this respect, according to acts which involve the exercise of judgment, reflection, comparison, &c., and very variously, also, according to individual suggestions of Reason, Passion, love of sensual gratifications, the exigencies of disease, &c.

Since, therefore, Instinct has its special constitution conforming to the organization of the stomach and the peculiarities of the gastric juice, we shall see how far it is related in its peculiarities to other varieties in the mechanism of organic life, by considering how all these varieties in every species, respectively, have an equally direct reference as the peculiarities of Instinct, to the special organization of the stomach, and special constitution of the gastric juice. If, therefore, such be the relation of the whole mechanism of animals, both organic and animal, to the special condition of the stomach and gastric juice in their adaptations to the varieties of food in the several species, it is obvious that Instinct in all the species, respectively, must be constituted with a corresponding reference to every part of the organic whole. Now, an intestine, claw, hoof, tooth, or any bone of an unknown animal being given, we may construct a skeleton, say from the bone, that shall be true to nature in all its parts. We may thus proceed to cover it with muscles, provide it with claws or hoofs, and special kinds of teeth, &c., and, lastly, we can tell from that tooth, or claw, or hoof, or other bone, what was the structure of the digestive apparatus, and to what kind of food the gastric juice was specifically adapted, and what were the peculiar Instinct and habits of the animal; so special is the adaptation of all other parts of the organism, both in animal and organic life, to the peculiarities of the stomach in every species, and so exactly conformable are the *Instincts* and habits of animals to all that vast range of physical peculiarities in the several species respectively.

The foregoing is also true of man as it relates to organization. But who could surmise from any part, or from the whole of his organism, that he is endowed with Rational Faculties, or with any thing more than what is common to brute animals? Here begins, abruptly, a total distinction between man and animals—nothing whatever in the mechanism of either to denote the ending of one or the beginning of the other. Nothing, indeed, but analogy, founded upon observation, enables us to affirm with certainty the same principles of extinct species of animals. Nothing but observation informs us of either the physical or mental functions; for neither could have been deduced from structure alone. And yet analogy is so perfect a guide where the continuity of the chain is unbroken, that no error can arise in scanning the Designs of Infinite Wisdom, so far as they are submitted to human inquiry. But analogy in relation to Instinct snaps in man. This might render it difficult, if not impossible, to know the great fact, had all the species of quadrumanous animals become extinct before man began his observations in natural history. The subsequent discovery of the skeleton of a chimpanzee would doubtless have been regarded as an unanswerable proof that there had been, at least, other beings upon earth besides the human race who

had enjoyed the prerogatives of Reason, and so a descending analogy imagined down to the polypi.* But, the chimpanzee is a thousand times less endowed with Instinct than the honey-bee; and we have seen that the sense of instinctive promptings throughout all animal tribes is concerned about objects which Reason regards as only tributary to those immeasurably higher occupations of the Soul which have no relation whatever to those of the Instinctive Principle.—NOTE PP p. 1142.

§ 1078, *f*. However the foregoing branch of our inquiry (§ 1078, *e*) may be pursued, it will always result in the same uniform way. Consider, for example, the correspondence between the Instincts of animals and their weapons of offence and defence; each species of animals, and all the individuals of a species, acting defensively or offensively according to the special weapons with which they are provided. These means of preservation have a direct reference to organic life, and Instinct, therefore, is adapted to the nature of the means. The various provisions are not only such as are actively employed, both for the purpose of procuring food and for self-preservation, like the weapon of the sword-fish, claws, the poison of serpents, &c., but others for the simple object of self-protection, such as horns, the quills of the porcupine, the armour of the rhinoceros, the sting of bees, the galvanism of the electrical eel, the ink of the cuttle-fish, &c. Again, certain animals, and many of them of inferior orders, as some species of cockroaches, some of worms, often affect the appearance of death when closely pursued; and when this is seen in one animal, it is, as in the preceding cases, common to all the individuals of the species. Many other animals that keep near the ground are protected by their colour, and the animal, when alarmed, lies close. In all the cases there is a manifest unity of designs which conspire together for the well-being of organic life. Whatever may be the means of defence, of offence, of flight, or of whatever variety or modification, they are adapted to all the mechanism in animal life, to special sensation, &c., and according to the whole will be the special promptings of Instinct.—NOTE C p. 1113.

§ 1078, *g*. Fear, therefore, operates in animals impulsively, while in man it is the result of judgment, reflection, comparison, and his modes of defence are suggested accordingly. Observe, also, another fact relative to fear, which equally separates Instinct from the Soul. The young animal will turn from danger about as impulsively as the adult, while the human infant will thrust its hand into the blaze of a candle sooner than it will seize the nourishment that is simultaneously offered. In animals, indeed, the most exquisite sensitiveness to danger prevails, transcending even the promptings of hunger. Its predominance is designed alone for the preservation of organic life, and such are their exposures, and so limited their conceptions, that it is made to operate with great uniformity and instantaneousness. In man, on the contrary, its impulses are comparatively feeble and slow, and so far as it obtains, it aims at a variety of objects which are determined by the decisions of Reason. The principle, in animals, is evidently allied to that characteristic which directs their migrations, and the homeward flight of the bee.

The manifest dependence, in man, of a sense of danger, and his expedients for self-protection, upon the Rational Faculties, has led to comparisons of certain Instinctive perceptions of danger in animals, with a view to the identity of Instinct and Reason, of which one of the strongest is often seen in the elephant on crossing a bridge, or embarking on a steam-

* Who will doubt this, now that the much-lauded work of DARWIN *On the Origin of Species* has made its appearance? See p. 814. *note*.—1860.

boat, as he first presses the bridge or the boat with a single foot to learn their stability. But this example is peculiarly adapted to our purpose, since Instinct is here constituted with a reference to the weight of the animal, who would be otherwise exposed to frequent injuries; and the associations that are indispensable to safety are early formed. But they go no farther, and this particular demonstration is seen only in animals that may break a bridge or sink a boat. It is, therefore, only an instance of the ordinary impulsive associations which are always in operation in cases of danger, and is exactly similar to the careful tread of the smooth-shod horse when about stepping upon ice, or the wariness of the fox and the rat in eluding the trap, or the various expedients of the squirrel in dodging the sportsman, or the cautious nibble of the fish, &c. The varieties in these examples are almost as great as the species of animals, and they all belong to the exquisite intuitive principle which warns them of approaching danger. It is often seen, indeed, in the aspect of mutual protection among animals of the same species, when it always operates according to the nature of the species. The crow has his sentinel, and the affrighted ant communicates its alarm by a peculiar touch of its companion, which spreads with rapidity from one to another, till the whole hive is quickly thrown into this paroxysmal movement. And now, if this analysis be pursued through an obvious series of analogies, it will be found that the habits of bees in relation to their queen, and many other remarkable problems in the history of Instinct, are allied to the principle which I have just considered.

§ 1078, *h*. Another shade of difference in the general principle occurs in an example which has been presented by Metaphysicians to illustrate the supposed identity of Instinct and Reason. It is that of a dog, who has appeared, when making for a drifting boat, to lay out the plan of first ascending the bank of a stream above the boat, that the distance between himself and the object may compensate for the motion of the water, which would otherwise carry him below his destination. I present the example in its strongest light, and as implying all that can be surmised of a rational process in animals. But, with all instances of a similar nature, it falls within the common laws of the Instinctive Principle, which are just so far operative, according to the species of animal, as shall subserve the exigencies of life. In the case of the dog, this animal is more or less addicted to the water (especially the individual in question), and his Instinct is therefore adapted to the emergencies that may attend that temporary mode of life. He early acquires, in consequence, an impulsive apprehension of the effects of strong currents of water, and is so far capable of forming associations as may be necessary to his safety, or to his natural wants. The instance of the boat is one of safety and of want, and is exactly parallel with that where all dogs will elect a bridge of 500 feet in preference to swimming the width of a dozen. The knowledge of the effects of a current of water exceeds but little that of its quality of wetting; and when, therefore, a dog is moved by the desire of bathing, he neglects the bridge and takes to the water.

Various prejudices and misapprehensions relative to supposed instinctive acts abound in the community, who are prone to the most favourable comparison of the brute with his lordly associate. The rarity of apparent evidences of Reason in brutes, and the enjoyment of what is thus unexpected and wonderful, lead the multitude to seize upon what is accidental and carry it to the account of Instinct. An example of this,

which has often gone the round of the public, is that of the elephant and the apple, where the tempting morsel, being just beyond the grasping range of the animal's trunk, was made, by a forcible projectile blow, to rebound within its reach from an opposite wall. This has been thought to be but little inferior to a game at billiards. But it was simply an act of irritation, the blow being designed in the same resentment as when an angry man loses all reason and castigates a stone that has caused him an injury.—NOTE P p. 1121.

§ 1078, *i*. The Speculatist points to the care with which animals provide for their young, and the great resemblance between them and man in parental attachments, as an evidence of the supposed identity of Reason and Instinct. But I answer that this is much more seeming than real, and that however the principle may have an ultimate reference to the well-being of organic life in the infancy of man, it embraces in him far loftier objects, and prompts to an endless variety of useful purposes in the care of his progeny which have not the least connection with the exigencies of life, but which, on the contrary, are relative to the culture, the enjoyments, the morality, the Religion, the eternal welfare of the Spiritual part. It follows them through all the stages and vicissitudes of life, rejoices in their happiness, and grieves for their adversities. When intercourse fails, every expedient is devised, from the tardy messenger to the electric telegraph, to impart renewed expressions of affection, and fresh hopes of prosperity. And how is it on the part of the offspring? Does not every heart beat responsively to the Divine command to "honour thy father and thy mother?" And can there be a broader distinction between the attachments of animals and of mankind than what Scripture implies and what man pursues? The very attachments which man contracts for favourite animals flow from the Divine sentiment which is impressed upon his Soul. And then all that display of sympathy and friendship among companions of mutual thoughts, or of heartfelt kindness towards the faithful and trusty servant, or the universal characteristic known as the sentiment of humanity—where, I say, shall we look for the dawning of these mental attributes in the constitution of Instinct? And wherein are the instinctive movements of animals towards their offspring related to human affections? Simply for the preservation of life, and thus incidentally for the perpetuation of the species, as conclusively shown by the total and abrupt disappearance of brute attachments as soon as the offspring can provide for and protect themselves, and this, too, at ordained times according to the species of animal. Nay more; parents and offspring mutually abandon each other at allotted times, and turn upon each other. The principle is seen in full operation, and in its largest extent, in the bird while hatching her eggs. She may be in expectation, though she may have had no more experience in the final result than the bee on its return after its first wandering from the hive; nor is there any more similitude with the operations of reason in the one case than the other; she will as readily sit upon counterfeit eggs as her own till her time of "reckoning" is up, and then abandon them.

§ 1078, *k*. The same distinction (§ 1078, *i*) exists between the love of the sexes in the human race and what is observed of the sexual relations in the brute creation, and is not less opposed than our other facts to the assumed identity of Reason and Instinct. Like all else in relation to the latter, the impulse is totally restricted to the perpetuation of or-

ganic life. In the human species the same impulse is as a spark in a blaze of fire. The principle of love takes in its scope the loftiest sentiments of Mind, and anticipates all the intellectual endearments of domestic society, and yields a grateful tribute to its munificent Author. If there be a low analogy, it is of the lowest grade, and is nearly lost in the sublimity of its intellectual accompaniments. Nor can there be a parallel suggested between Reason and Instinct more degrading to man, or more unjust to his Maker, or more characteristic of a perverted mind, than that which is so often drawn in respect to human and brute affections. Yet he who makes it has a better opinion of himself, and only thinks so of the rest of his race.

§ 1078, *l.* And this leads me to speak of the very remarkable distinction between the Soul and Instinctive Principle known as *Conscience.* I employ the term in its popular acceptation, as meaning the ability and the impulse of man to decide on the lawfulness or unlawfulness of his own actions and affections, and to instantly approve or condemn them according to their nature. Nothing like this has ever been observed in animals. It is purely intellectual, and has a clear reference to the moral, Religious, and social condition of the human race. It may be said, however, to be apparent in some animals, as when the dog, for example, manifests a sense of wrong when he surprises the game in a manner opposed to his instruction, or does other analogous acts. But this manifestation happens only under the influence of those physical causes which led him to act more habitually in a different manner. The sense of wrong does not originate from the act, or on account of the act, but is excited by the presence of his master, whom he associates with the suffering which he endured when his Instinct was undergoing discipline, and thus resolves itself into a dread of punishment. It is therefore exactly analogous to all the other functions of Instinct which I have indicated, and forms the limit of associations of which animals are capable.—NOTE P.

§ 1078, *m.* And what shall be said of that other principle, scarcely less universal and impulsive than conscience—a love of *Fame* and a desire to live in the memory of posterity? The question becomes ridiculous in its application to animals, and is hardly less so, in an abstract sense, as it relates to man. But, as an incentive to laudable action, it is a noble offspring of Reason, and as significant of the Soul's immortality it rises into sublimity.

§ 1078, *n.* And what of Religion? What of the universal desire of immortality? What of a sense of dependence upon a Superior Being? It may be safely affirmed that animals have no other knowledge of their own existence than what arises from present sensations; and should a chimpanzee be seen bowing even to an idol, it would be a greater phenomenon than the expostulation of Balaam's ass.

§ 1078, *o.* Even *memory*, as it belongs to animals, is nothing but an association awakened by some present impression upon the senses. It is indispensable, however, to many of their wants and habits, and hence is so strongly pronounced in many species that they will recognize objects after a separation for long intervals of time, particularly where strong impressions had been made, as between the dog and his master, and wild beasts and their former keepers. In man, on the contrary, memory is often relative alone to acquirements which the mind has made through its own processes of reflection, and they may be as vast and profound as the elaborate inductions which led to the discovery of the universal law

of gravitation, and thence to the calculation of the existence of the planet Neptune. Nor does memory, in man, require any extraneous aid, like the apparently corresponding function in animals. It is a rational function in one, independent of sense; an instinctive one in the other, and dependent upon sense. In one, it always involves an exercise of Reason, and often a vast complexity of ideas; in the other, it is simply relative to the single impression which had been transmitted to the brain by some external cause, and which can be recalled only by renewed applications of the same or analogous causes.* By extending the analysis in this manner, it will be seen that it is all Soul in man, and all Instinct in animals.

§ 1078, *p.* But the most curious problem in the history of Instinct is its natural mutations in certain animals, and which carry with them an abundant proof of the radical distinctions between that Principle and the Soul, and that the former is designed for the mere purposes of organic life. I shall therefore give to the subject a greater consideration than would be otherwise expedient.

This characteristic is seen, especially, in animals that are subject to metamorphosis, though in many of the instances the changes of organization and the modifications of Instinct are far greater than in others. The strongest examples occur in insects, a large proportion of which have four stages of existence: the egg, the larva, the pupa, and the imago, with corresponding instinctive habits in the last three. Where the metamorphoses are most remarkable, as in the foregoing examples, some of the organs undergo mutations that require a change in the stimuli of life which could not be realized without corresponding adaptations of Instinct. This is also more conspicuously illustrated by the difference in the wants and habits of those animals which at one period breathe in the water with gills, or analogous organs, and subsequently in the air with lungs.

Now these metamorphoses are as much the exact result of determinate laws, ingrafted upon an original constitution of life, as the development of the human ovum, or the seed of a plant; nor are they in any respect more fluctuating or less circumscribed (§ 72, 1051); and so a corresponding law obtains in respect to Instinct, through which the promptings of Instinct shall harmonize with those modifications of organic life that distinguish the several stages of metamorphosis. In all the cases, from the plant to the insect, and from the insect to man, the metamorphoses or other developments, and modifications of life, take place in one uniform way, according to the species of animal or plant. A potential whole, embracing all the special conditions necessary to the progressive changes from the ovum, through the larva and pupa to the fly, and in all analogous instances, is as perfect in the most mutable tribes as in the ova of the highest order of animals, or in the seeds of plants; and, since there can be no departure from a precise and uniform succession of developments in any of the species, respectively, we also learn that there is no transmutation of species, nor even an introduction of varieties (§ 1051, *primordial cell*).—Note Pp p. 1142.

In respect to the various physical agents required by animals subject to metamorphosis, according to their several stages, the principle is alike ingrafted upon the ovum, and equally so in the case of man, by which his development is started by one kind of vital stimulus, and is farther conducted through fœtal life by another kind, while a variety obtain after independent life begins. It is a metamorphosis in all (§ 63–81).

* Note Hh p. 1138.

This brings us to the particular application of our subject, the simple subserviency of Instinct to the exigencies of organic life. Here it is, in the well-marked metamorphic animals, that it is distinctly seen that all its modifications keep pace, *pari passu*, with the changes of organization, and that the law is exactly coincident with that which respects the changes of structure, and is designed alone to fulfil the necessities of the latter. They equally spring from a common principle of mutation implanted in the germ.

§ 1078, *q*. There remains to be considered the comparative independence of the Soul in the exercise of its highest functions; when, also, certain anatomical facts between man and animals will be reviewed for the purpose of contrasting them in yet other relations to the Soul and Instinct.

Although there be a co-operation of the brain with the Soul in all acts of intellection, it does not follow from what has been said that the Rational may not act in greater independence of the organ than the Instinctive faculty. Just otherwise, indeed; for my argument to this effect is founded, in part, upon the distinctions which I have indicated between the Soul and Instinct, and upon what I am about to say of the general coincidence between the brain of man and of the highest orders of animals, though an opposite conclusion has been deduced from this relation. But the inference as to the equal dependence of the operations of the Soul and Instinct upon a concurrent action of the brain or its equivalent has also depended upon a neglect of the distinction in their attributes, or an assumption that there is no difference. The analogy in such a case would be sound and conclusive so far as it respects man and the approximate animals. But our premises are indisputable, that all the higher acts of intellection, everything which falls within the province of Reason, have no existence in animals. It is the only thing, indeed, which essentially distinguishes man from the brute, and would be in itself conclusive against the somewhat prevailing doctrine that man was once a member of the quadrumanous race. We have also seen that Instinct is more comprehensive in many insects where a ganglion takes the place of a brain, and far more allied in its operations to the plans of Reason, than in the highest order of animals, and is often as mature in the new-born as in the adult being; and since, also, the organization of the brain of the higher animals is greatly like that of man, but without any of his intellectual functions, we must logically conclude that what is so absolutely peculiar to the Soul, and, as generally granted, allied to God Himself, acts in greater independence of the brain than does simple Instinct. But, so inscrutable are its connections, as well as those of Instinct, with the organ in which it resides, that I shall not trespass beyond the limits which are prescribed by observation. Our facts terminate abruptly at this point, and mystery begins. But we may pursue the facts, and reason upon them as upon the most tangible evidence. We will therefore interrogate other proof in support of my conclusions.—NOTES PP p. 1142, QQ p. 1145.

We have seen that every variety of cerebral structure, from its approximation to man's in the higher animals to its disappearance in a scarcely appreciable ganglion in the lower tribes, is attended throughout with undeviating and perfect manifestations of Instinct, though according to the nature of the animal, while they are only dimly seen in the human species. This, in respect to Instinct, is conformable with all analogy as it regards other organs where the results depend upon anatomical structure

acting through the principle of Organic Life. There is every variety, for example, in the organization of the liver, from its greatest elaboration in man and the higher animals until we meet with it in the lower orders as a bundle of tubes or a simple sac. Yet in all it generates a product which is nearly the same, and which performs the same office throughout. And so of the kidneys, salivary glands, stomach, &c.

So far the analogy is complete between Instinct and its organ and the Principle of Life and all parts of the body which that Principle animates. But Instinct, as we have seen (§ 1076, *a–c*), must not, therefore, be confounded with organic products. The analogy, indeed, goes with our other facts in showing that it is the *cause* of certain results through the instrumentality of the brain, or its equivalent, and the nervous system, as the Principle of Life is the *cause* of other results in and through that same system of organs and every other variety of structure.

Coming to the brain of man, the foregoing analogy totally fails as it respects the manifestations of Reason and Instinct. There is an endless variety of the former, but scarcely a real exhibition of the latter. We see all in the structure of the fully developed animal brain that can be detected in the human, or with only the modifications that are incident to approximate species, but a perfect blank as it respects the Rational Faculties. The analogy, however, is complete in man's so far as the brain subserves all that Instinct can discharge among the animal tribes, and all that is relative to the latter in the contributions which the nervous system makes to organic life. The only difference here is the substitution of the Intellectual for the Instinctive functions; and whatever relates to the manifestations of Instinct, and all the influence of the passions upon the organs of organic life, are demonstrative of the co-operation of the brain with the Soul. But the moment we leave this ground, and approach the abstract operations of the higher faculties of the Soul, there is very little direct indication that the brain has any functional connection with the processes, however much its integrity may be necessary; and the only foundation for the conclusion that such connection exists are the results of sensation and the analogy supplied by Reason in its exercise of the voluntary and other Instinctive functions of animals (§ 1078 *a*, &c.).

Again: we have seen that in the infancy of man the Mind is inoperative, while the Instinctive Principle of animals is nearly as active and comprehensive in their earliest as in their latest stage of existence. We have also seen that Instinct is susceptible of artificial impressions, resembling education, in the infancy of animals, and only then. This distinction can proceed only from a radical difference between the Soul and Instinct; and the attendant final causes of that difference consist in the special design of the Soul for Rational functions when the body is sufficiently mature for any practical purposes, and of Instinct for the simple uses of the body. The necessity of Instinct, it may be farther said, is superseded in man not only by the endowments of Reason when it comes into individual operation, but by its delegated offices before its development takes place, while no such protective care, as a general fact, can be extended by the Instinctive Principle to the new-born animal. Hence, therefore, as there are no superfluities in Nature, Instinct is in full operation at the birth of animals, when there is no display of it in the human race, nor is the Soul only slowly developed in its Rational faculties. And thus do the physiological facts, the manifestations of Reason and of Instinct, and the final causes concur together.

And now comes up the remarkable anatomical fact, which goes also to the same conclusions (although supposed to be in opposition to them), that Instinctive acts are irrespective of the progressive stages of cerebral development, while those of the Human Mind await that development. This corresponds, in respect to animals, exactly with what we know of the general maturity of the functions of all other parts at all stages of life, and with what we have seen of the objects of Instinct and Reason, since the former must be in early operation for the exigencies of Organic Life, while the Soul, in the complexity of its functions, and according to its objects, is only ready to act when the brain shall have acquired sufficient maturity for those endless physical impressions which come through the medium of the senses, and from which the Soul gathers its earliest treasures of knowledge.

Such, then, is the relative aspect in which must be regarded the correspondence between the progressive development and maturity of the brain and the operations of Mind in early life; the development or maturity of the brain having as well a reference to the multifarious physical contributions from the Senses, as to their appropriation by the Soul; while, also, the admirable Design obtains of rendering the brain complete in all its relations to the organs of Organic Life from the moment of birth, and, on the other hand, its endowment for the uses of the Soul exactly progressive with those physical developments of other parts that are indispensable to the objects of Reason at the different stages of advancing life. The Design is inexpressibly sublime in its numerous, yet distinct involutions as they relate to organic and animal life and the uses of Reason. The Soul, therefore, may be, abstractly considered, in as perfect a state in infancy as at any stage of life.

Thus it appears, that, besides the physical development of the brain which is requisite for the impression of natural objects, that maturity of the organ is, also, as a part of the design, a necessary medium through which the Soul may appropriate the impressions. Having made these advances, the Soul comes to act in more or less independence of sensation, and to multiply knowledge by its own efforts. Nevertheless, it is peculiarly useful to my purposes that aberrations are seen of occasional displays of Reason in early childhood which are surpassed at adult age only by genius of the highest order. In some of these rare instances there had been only the most slender antecedent relative knowledge acquired through the medium of the senses, but the Soul itself originated its own vast conceptions, carried them into a variety of practical applications without the instrumentality of foreign aid, and to an extent where erudition, with all the appliances of sense and the facilities of instruction, falls far short of equal achievements—as witnessed in the institution of mathematical principles and processes. And here we strengthen our position by the converse rule, since in none of the cases has there been a ratio in the advances of Mind corresponding with the advancing maturity of the brain, while in some the early intellectual ability has settled down at adult age to a common mediocrity. In the latter case it cannot be doubted that the progress of the brain has embarrassed the Rational Faculties. Again, there is every gradation in Reason from the Hottentot to the highest order of genius. There are no two individuals alike either in its compass or in the manner of its exercise. How different is all this with Instinct, which directs every individual of every species of animal in one uniform way, and no one of

them enjoys, throughout all generations, any different or greater endowment than all the rest.

And thus do the contrasts between the Soul and Instinctive Principle correspond with the anatomical contrasts, both as they relate to the brain of man and of animals, and to the human brain and other organs in the state of infancy, and with the coincidences in function, instinctive and organic, between the brain of animals or its equivalent and other organs at all stages of life. And here, too, should be brought into review what has been said of the injuries which are inflicted upon the Mind and its associate organ, and through those influences upon the whole organism, by overtasking the Mind in early life, while no such injuries are sustained, but the contrary realized, by a severe exercise of Instinct in the infancy of animals (§ 563–568).—Note Pp p. 1142.

§ 1078, *r*. It may be now well to inquire into what is meant by *ideas*, and whether there be generally any definite conception of their nature, and, by ascertaining the facts, endeavour to show by this method that the earliest acquirements through the instrumentality of the senses demonstrate the self-acting and originating endowment of Mind, and that it is distinguished, at its very dawning, from the Instinctive Principle, by the characteristic of forming ideas of the *nature* of objects. This inquiry, like the rest, belongs alone to the Physiologist. How, then, does sensation give rise to what are recognized as *ideas* by Reason? The impressions transmitted to the brain through the organs of sense, or such as may arise from internal causes, do not, certainly, constitute the *ideas*, as is apt to be supposed; and, according to my demonstration, the impressions made upon the brain cannot, through any physical or chemical influences upon the organ, elicit the ideas from the organ itself. The impressions must, therefore, of necessity, call into action a Principle or Agent by which the ideas are alone formed; from which it appears that the process, by which the Mind seizes and appropriates impressions transmitted through the organs of sense, is similar to that by which it multiplies and originates ideas. It is true, animals have the capacity of forming ideas so far as they depend upon the promptings of sensation, and upon impulsive associations with the past that may be awakened by renewed sensations of a more simple nature. But they stop there. They are merely ideas of sensation; while, on the other hand, the results of sensation in man terminate in intellectual images which have no analogies in the brute creation, and these are the essential final cause of the human Soul. It is the Soul, therefore, which, mainly, does the work in acts of intellection, while, in respect to the simple ideas of sensation, external objects, or internal causes like that of hunger, supply the materials. This is enough for my purposes; and it will be as vain to inquire into the *modus operandi* of the Mind in its abstract operations, or in its perception of external objects, or how impressions are made upon the nerves of sense, or what their nature, or how they are transmitted by the nerves to the brain, or how they call the Mind or Instinct into action, as to interrogate the *modus operandi* of Creative Energy.

§ 1078, *s*. In drawing to the close of our subject, we are naturally led to inquire whether there be more than one species of the human race—a question which is unusually agitated at the present day.

Taking the extremes of the race in physical and intellectual development, it appears to have been definitively shown that there are no anatomical characteristics which distinguish them as different species, but,

on the contrary, mark them as one. All the differences are susceptible of ready explanation through the influences of climate, habits, &c., unless, perhaps, the black color of the African (§ 604–611). The Malpighian *rete* is abandoned as fallacious, and the color of all the races is now known to depend upon carbonaceous matter deposited upon the surface of the true skin, differing only in degrees of intensity. The greater tint of the Negro has been referred, in a very ingenious Essay by Professor Müller of Brussels, to the hot and arid climate which the darkest of that race inhabit. But, with all his experience in those regions, he is mistaken in his important point that the newborn Negro is white; and his doctrine of the influences of deficient oxygen and dryness of the air in occasioning the deposition and fixedness of the cutaneous carbon is inapplicable to the North American Indian, whose skin is as dark in his extreme Northern as Southern limits; nor has a Northern climate exerted a bleaching effect, in many generations, upon the Negro in America. Müller's theory, therefore, of excess of carbon in the blood from an inadequate supply of oxygen by the rarefied air of the tropics, is invalidated by the exceptions before us. Nevertheless, peculiarities of climate have, doubtless, given rise to all the shades of color, unless that of the Negro form an exception (§ 610). A simultaneous *lusus naturæ* of a male and female *black*, as in the case of the *white* Negro, may have given origin to the race. (Vide *Med. and Physiolog. Comm.*, vol. ii., p. 640.)

§ 1079, *a.* Such are the conclusions (§ 1069–1078) to which the evidence of anatomical and physiological facts have successively led; nor have I any doubt that others will see in the demonstrations that man is an animal only in his physical being; that in Mind he is far less allied to the things of the earth than he is to their Author; and will realize a corroboration of their own conceptions, that the Soul and Instinctive Principle are so far differently constituted as implied by the ultimate existence of one in an abstract condition, while the other shares the destiny of organic life. They will see, I say, a new ground of belief in the immortality of the Soul, and in the perishable nature of Instinct. And if this be so, they will see in my premises and conclusions a contradistinction between God and Nature, and what is equivalent to a demonstration of the existence of a Creative Spirit, in which alone the Thinking part of man can have had its origin. And, coming to other details in relation to man, they will realize in the Mosaic declaration that "the Lord God formed man of the dust of the ground, and breathed into his nostrils the breath of life, and *man became a living Soul*," an Inspiration from Him Who "created man in His Own Image," and repose with equal confidence in the assurance that, although "the dust shall return to the earth as it was, *the Spirit shall return unto the God Who gave it.*" They will abide in the emphatic distinctions between the dust, the breath, and the Soul, and regard the Spirit as a special gift, a new Creation, and the body as referring to materials already in being, and which were designed in their organic state, and kindled into life, to connect the Spiritual part with the material world; and they will also see in the limitation of the statement as to the Soul of man what is the ultimate destiny of Instinct.

Hence it follows, if Revelation be received as to the *immortality* of the Soul and the *death* of Instinct, it must be received, also, as revealing a fundamental distinction between them, and should operate as a perfect barrier with all those who uphold the Scriptures against the common

prejudice of identifying Instinct and Reason, as confounding the revealed distinction, and therefore promoting infidelity in its aim at materialism and annihilation.—Notes Pp p. 1142, qQ p. 1145.

§ 1079, *b*. The foregoing subject has been pursued by the Author in a long Article upon "Theoretical Geology," in the "*Protestant Episcopal Quarterly Review*," New York, April, 1856, in which he has endeavoured to defend, upon scientific, philological, and geological grounds, the literal interpretation of the Mosaic Narratives of Creation and of the Noachian Flood; and, should he think that the spirit of the times will justify the publication of the larger work to which he referred in the original edition of the Essay on the Soul and Instinct, and which is now completed, he will submit it to the press. His main difficulty is the general concurrence of the Religious press in the revolutionary views of Theoretical Geology, though, in saying this, nothing more is intended than a simple representation of the facts. It is doubtful, therefore, whether a hearing can be obtained—certainly not a publisher at his own risk. The Author makes this statement in consideration of his former announcement that such a work was on hand.—See Supplement, p. 923–928, § 1085.

The "Review of Theoretical Geology," to which reference is now made (extending to 120 pages), is an epitome of the larger work, and is believed by the Author, and by better judges, to be incontrovertible. This is said, however, simply for the purpose of inviting a criticism which may either discourage the Author in a farther attempt, or prove to him an incentive to go on with his solitary work. He acknowledges, however, some encouragement in a critical review of Hugh Miller's posthumous work on the "*Testimony of the Rocks*," which occupies five pages of the Westminster Review for July, 1857, and which is remarkable for its contrast with an otherwise apparently universal shout of applause.*

§ 1080. Again: such is the nature of our premises, that, if the Soul of man be *immaterial*, so is the Instinct of animals. There are, moreover, no violent transitions in nature. The material existences, especially the organic, pass gradually, as it were, into each other. And so, it cannot be doubted, it is with the immaterial, from brute to man, from man to angels, from angels to God.

> "Of systems possible, if 'tis confessed
> That Wisdom Infinite must form the best,
> Where all must fall or not coherent be,
> And all that rises, rise in due degree;
> Then, in the scale of *reasoning life*, 'tis plain,
> There must be somewhere such a rank as man;
> And all the question (wrangle e'er so long)
> Is only this: if God has placed him wrong?"

But we have also seen from our premises that, as soon as Instinct shall have fulfilled its objects, it perishes with the life of the animal; since, especially, all its present uses are limited to the wants of the body. Nor will its extinction affect the analogy of which we predicate its *immateriality*, nor contradict in the least the *immortality* of the Soul. We deduce the latter, apart from Revelation, not from the Soul's *immateriality*, but from some of the facts which contradistinguish it from Instinct, that all its higher faculties have no relation to the uses of the body, and from the analogy which subsists between them and the Attributes of the Creator. We infer, also, the *immateriality* of the Soul, in part, from the same analogy; though it is essential to this analogy that it be conceded that the Omniscient, Omnipresent, and Omnipotent Being is as different

* A protest against the geological and astronomical perversions of Holy Writ has just been signed (1865) by two hundred eminent scientific men of Great Britain.

from the inert matter of which He is the Author as their manifestations are different from each other. And again, if these premises be admitted, it follows that *immateriality*, or something totally distinct from matter, is indispensable to the unlimited duration of the Almighty, and therefore that it must be rendered equally so to the Soul. But the acknowledgment of a Creator carries with it a full admission of His immateriality, otherwise matter would be self-existent, and God and the Universe would be on common ground. The latter is replete with design, and that is the most that could be affirmed of the former. Neither should depend for its existence upon the other; nor, as we have seen, can matter create matter (§ 14 *c*). *Materialism*, therefore, is *pantheism—atheism.*

It need not be repeated that the *immateriality* of Instinct is inferred from its feeble analogies to the Soul, though not in the least to any manifestations of those attributes which ally the Soul to its Maker.*

§ 1081. It will have been seen that *materialism*, in its proper acceptation, and the question as to the *materiality* of the Soul, are distinct from each other, since the former denies the existence of the Soul as a substantive agent, while the latter admits it. My object has been to substantiate the *existence*, more than the *immateriality* of the Soul. But the proof of the latter has constantly attended all that I have shown of the *self-acting* nature both of the Soul and Instinctive Principle, which contradistinguishes them from every known attribute of matter. The nearest approximation, in the light of analogy, to what may be material, is to be seen in the Principle of Organic Life; and here the resemblance consists in action alone. But the Principle of Life requires the operation of numerous physical causes to bring and maintain it in sensible action. It is impossible, therefore, to adduce a single phenomenon of the Soul or of Instinct that bears a resemblance to the manifestations of matter.

§ 1082. Our inquiry may be variously pursued, especially upon the great basis of analogy. It is one of no little moment at the present day, and materialism must abide its own facts and method of reasoning; a ground, however, which nothing can shake when presented according to its ordination in nature. In the present case, the admitted facts are co-extensive with all animal existences, and they are bound together in the different races by close resemblances. Indeed, in each of the series the facts differ only by shades. The evidence here is of the strongest possible nature, not only on account of the universality of the facts, but because they are founded in the unchanging character of organic beings.

Resting, therefore, in the conclusions which I have now expressed, and anxious for their greater prevalence against a progressive and already widespread materialism, I have been led into this discussion in the hope that it may remove some of the obscurities of the subject, and also advance the great truths in Physiology and Medicine. The province of the Physiologist extends beyond the mere physical relations of matter and Mind. Of those relations he is the only expounder. But it devolves upon him, also, to seek in the depths of Physiology for the constitution of Mind as distinguished from matter; and thus, also, contribute towards a right faith in a future state of being. Wherever, indeed,

* We have seen, § 168, that Professor Müller, in discussing the nature of the *Vital Principle*, concedes that even this may be an *immaterial* substance, and that "there is nothing in the facts of natural science which argues against its possibility, and its independence of matter, though its powers be manifested in organic bodies—in matter."

he turns his inquiries into organic nature, he sees in the mechanism of every part—individually and collectively as a harmonious whole—in every function and product, separately and relatively—in the properties by which they are carried on, and in the laws by which they are governed, the most perfect evidences of consummate Design. It is the duty of the Physiologist to turn all this immense weight of proof against those crude doctrines of materialism, mental and medical, which have had their origin either in the closet of the speculatist or in the laboratory of the Organic Chemist. And thus, also, shall he secure from Mankind that homage for Medicine which is due to "the Divine Art," and again restore the Hippocratic axiom that "a philosophical physician is like a god" (§ 235).

§ 1083. Before concluding our subject I shall avail myself of the proof which it supplies against the doctrine of *spontaneity* of living beings, now extensively prevalent in the scientific world, and against which I have alleged many objections in the *Medical and Physiological Commentaries* (vol. ii., p. 123–140), and again in the original Essay on the "*Soul and Instinct*," and in that upon "*Theoretical Geology*" (§ 1079, *b*), and in these *Institutes* (§ 14 *c*, 170, 350¾ *a–m*).

As it respects the Soul and Instinctive Principle, we have now seen that they are *substantive* existences, and all organic beings are made up of the common elements of matter. But there is no element known in the inorganic kingdom which affords any of the manifestations which characterize the Soul and Instinct, or any of the results of the organic mechanism. The latter, therefore, was endowed with new properties when the elements were brought into organic union. To say that such properties were "slumbering in the elements," is a frivolous assumption (§ 14 *c*, 175 *d*, 250¾ *b*, *c*, *f–k*), and necessarily involves the conclusion (which has been probably intended) that the Soul, also, is equally inherent in the elements, which is the worst kind of materialism. But the manifestations of the Soul and Instinct are, as we have seen, not only totally different from those of every organic process, but cannot be generated by the material part. These principles, therefore, were as much created as the elements of matter, and, as they exist in union with the organized structure of man and animals, it is inferable that the structure was created simultaneously, and by a common act, with the spiritual part. Or, if the material elements were first combined, it would equally follow that it was a direct Creative Act, since the Soul and Instinctive Principle must have been created for the distinct purpose of being associated with the material body. The rule, of course, applies, through the analogies of structure, to the vegetable kingdom, and which it is equally consistent to suppose was created in the form of plants as of seeds, or as that man and mammiferous animals were created in a state of maturity, according to my demonstration in the Essay on the "Soul and Instinct" (p. 158–173).—Note Pp p. 1142.

I have also said in relation to the common opinion that intestinal worms are of spontaneous origin, that, if this be admitted, it must be also conceded by all that is sound in analogy, that the door is equally open for any other animal, and for man himself. The hypothesis is without a plausible fact, while the ova of these parasites, and of such as are found in the organization of the body, even in the fœtus, may require, in the natural external condition of the animals, a magnifying power of some hundreds of times to render them visible. They may, therefore,

be absorbed into the circulation, where their new mode of existence, as well as in the intestinal canal, may so modify the condition of the animals that they shall lose all resemblance to their characteristics in the external world. The animal and vegetable tribes abound with equally remarkable aberrations, that arise from climate, domestication, and cultivation alone. But more than this. From whence comes the elaborate organization of these so-called parasites and their wonderful systems of Design? How and from whence do they obtain, at their start into being, the seventeen or eighteen elements of which they are composed, and which are indispensable, in every species of animal and plant, to the beginning of existence? And should not this objection have been urged against the pretended creation of the *Acarus Crossii* out of a simple solution of silex in water (§ 350$\frac{3}{4}$, *h*)? Is there any thing in Chemistry that will expound the intimate union of such a number of elements into compounds of the most exact nature, or these compounds, by any thing known in physics, into systems of Design, and this for every species of animal and plant, if you had all the elements to begin with? Or, take oxygen, hydrogen, nitrogen, and carbon alone, the Chemist completely fails to fabricate the most simple organic compound (§ 350, No. 39, *parallel columns*). But by no possible contingency can the seventeen or eighteen elements have been assembled for a single individual plant or animal; and when all the species are regarded collectively, the supposition becomes palpably absurd. Nothing but Creative Power could have gathered them together in a single instance. This disposes, also, of the "*parturient faculty of the earth*," as it is called in the "*progressive development*" system of theoretical Geology. Nor can the pretence be set up that the so-called intestinal parasites grow out of a previously organized part, for they are perfectly independent beings, and have no attachments to the intestine. Or, if attachments exist in other cases, they are precisely upon common ground with parasite plants as it respects their original independence. The doctrine which ascribes *Muguet* "to the production of a parasite plant within the epithelial cell" is open to the same objections as apply to the spontaneity of animals, and is contradicted by all the physiological, pathological, and therapeutical facts. It is alone worthy of the most imaginative of the microscopical school, setting aside its pernicious tendencies in Religion* (*Continued* in § 1085.)

I can not but think, after all, that whoever regards the animalcule, that can be discerned only through a high magnifying power, in all its wonderful complexity of organization, seemingly existing in *nothing*, in all its close analogies in composition and structure to man himself, and often with a large development of the Instinctive Principle, and ponders upon the same analogies as they are only less complex in worms, and only still less in parasitic plants, and considers the stupendous Designs which each part, and all together in unison, fulfil for the growth and well-being of each individual, and how there is no deviation in structure and functions among all the individuals of the species respectively, must concede the descent of the whole from progenitors that had been brought into being by an Intelligence higher than that which is enabled to explore the labyrinth and trace out the Designs (§ 1051), and that thus informed, he must bow with reverential awe under the inspiration of such contemplations. (See INDEX I., *Article* DESIGN.)

* The Author is gratified to observe that the spirit of his arguments upon SPONTANEOUS GENERATION, as expressed here and elsewhere, is adopted in *Amer. Jour. of Science and Art*, May, 1859, and by the same writer as referred to in *note* at p. 196, § 360. *Comptes Rendus*, 1859, contains conclusive experiments in favor of CREATIVE POWER. —1860.—NOTES Pp p. 1142, Qq p. 1145.

THE RIGHTS OF AUTHORS.

§ 1084. Upon all questions of priority that concern the advancement of Science and Art, there is, doubtless, a general understanding that the principle should not only be sacredly observed, but that, whenever violated, there should be a common effort to repair the injury. This is alike due to the individual, to the principle, and to the common good. Nor is it less the privilege of the individual, who may have good reason to think that the principle has not been extended to himself, to vindicate his rights, and to appeal to that sympathy which forms the bond of union among honourable men. It is a common cause, and not seldom demands protection.

The Author of these Institutes (and it will soon appear that he acted wisely) has sometimes thought it expedient to assert his claim of originality, in advance, to many doctrines promulgated in the work; as, for example, all that is most essential in the application of the Nervous Power, or Reflex action of the nervous system to Pathology and Therapeutics, and to much of what is most important in the natural state of the functions. This may be readily seen by consulting p. 106, § 222 *b*, p. 107–116, § 224–234, p. 295–318, § 475½–493 *d*, p. 321–341, § 495–514, p. 343–353, § 516–524, p. 465–467, § 714–719, p. 506, § 803–804, p. 515–516, § 819 *b*, p. 661–663, § 894–896, p. 666–676, § 902 *b*–904, p. 679–680, § 905 *a*, p. 690–691, § 906 *g*, p. 693–695, § 917–923, p. 698, § 931–935, p. 703–711, § 940–952, p. 745, § 990½ *a*, *b*, &c., where all the subjects relate to the reflex action of the nervous system, and present the nervous power as an important vital agent in the various processes of organic and animal life, in the production of disease, in the operation of remedies, in all the results of bloodletting, in the changes which take place in the secreted and excreted products—having also originally set forth the agency of the nervous power in voluntary motion (Indexes, Article *Will*), and as this power is the efficient cause of the modifications of organic results under the influence of mental emotions (Index II., Article *Mental Emotions*, and references at p. 867, § 1067). Indeed, as the reader will have seen, the foregoing doctrines relative to the reflex action of the nervous power, operating as a vital *stimulus*, or vital *depressant*, or vital *alterative*, as it may be modified in its nature by one cause or another (§ 226–232, 481, 500, 891½ *k*, 894 *b*, 990½ *a*, *b*), pervade this work. The same doctrines are at the foundation of the Author's "*Medical and Physiological Commentaries*," published in 1840, while the present work was published in 1847. In the mean time he has also laboured to inculcate them throughout his course of Medical Lectures in the University of New York—first on the Institutes of Medicine and Materia Medica from the year 1841 to 1850, and subsequently, to the present time (1857), on General Therapeutics and Materia Medica.

It may be worth saying, also, that the Author preserves the term "sympathy," though always meaning by it, as he strictly defines, reflex action of the nervous system, and this whether he employs the term "remote sympathy" or "contiguous sympathy." The elements of sympathy, as set forth in the work, are the *nervous power* and *sensibility*. All

this will be readily seen by a reference to INDEXES. Also, among other general remarks of a similar import, the Author has the following:

"Notwithstanding all the laws of sympathy that are necessary to the full interpretation of the remote effects of morbific and remedial agents are as well established as any laws in physics, *they have not been applied to these important objects;* but, on the contrary, those philosophers who have contributed most to their critical exposition, *overlook their pathological and therapeutical bearings, and cling to the doctrines of humoralism and of the operation of remedies by absorption; nor have they applied, in the least, the nervous power in a philosophical manner to an explanation of the natural phenomena of sympathy*" (p. 111, § 234 *a*, 169 *e* 435 *c*, 906 *g*).

When the foregoing works were first published, it was in the midst of a universal prevalence of the chemical and physical doctrines of life and disease, and the Author stood alone in the field of Vital Physiology, and in the application of the reflex action of the nervous system in resolving the great problems in Physiology, Pathology, and Therapeutics. A few, however, had the quick sagacity to see its importance as presented by the Author; and since the decline of Organic Chemistry began, others have entered upon the inquiry, and the most zealous have promulgated as original with themselves many of the doctrines which belong to the Author of these Institutes, especially such as are relative to the nervous system. But the Author has relied upon his professional brethren for ultimate justice: "*Ultimum et unicum remedium.*" "*Jus aliquando dormitur, moritur nunquam.*"

But the Author has lately seen so great an indisposition, in certain quarters, to allow him any credit for his labours, that he has concluded to make this expostulation, which refers, particularly, to the following dispute about the authorship of matters in which neither of the gentlemen has any interest, but the writer alone of these Institutes. This rival claim appears in an Article published by J. ADAMS ALLEN, A.M., M.D., in the "*Medical Independent*" for September, 1857, p. 381, Detroit, Michigan. Thus:

"It appears from a late number of the London Lancet that M. Hall (Marshall Hall) recognizes to a certain extent the priority of Dr. Campbell. His words are these:

"'I arrive at this conclusion: the idea and the designation of an excito-*secretory* action belongs to Dr. Campbell, and his details are limited to pathology and observation. The elaborate experimental demonstration of reflex excito-secretory action is the result of the experimental labors of M. Claude Bernard. My own claim is of a very different character, and I renounce every other. It consists in the vast *generalization* of excito-motory action throughout the system. I trust Dr. Campbell will be satisfied with my adjudication. There is the excito-secretory function as applied to pathology, an ample field of inquiry for his life's career, and it is indisputably—HIS OWN. He first detected it, gave it its designation, and saw its vast importance.'"

Dr. ALLEN then continues:

"M. Hall thus far freely and fully admits the priority of Dr. Campbell, and the latter gentleman bases his claim upon the date, May, 1850. I shall undertake to show that this same doctrine was FIRST publicly announced and illustrated in my Lectures at the Indiana Medical College in November, 1848, and thenceforth continuously during the continuance of my public teaching before the several classes of that College,

and also the Medical Classes of the University of Michigan until my connection with that Institution 'expired by limitation' in 1854. My own manuscript containing this doctrine was written in May or June, 1848" —that is to say, *more than one year after the publication of these Institutes.*

"What I do claim *is the great generalization that the excito-influence is followed by a reflex change in which the effect is* NOT A MOTION, *but* A MODIFICATION OF VASCULAR AND NUTRIENT ACTION. *That this effect takes place* BY MEANS OF THE DOUBLE NERVOUS ARC. A vast number of therapeutic phenomena are thus explained." I preserve in the quotations Dr. A.'s capitals and italics.

Now the whole of the foregoing doctrine is impressed upon the *Med. and Physiolog. Commentaries*, and upon more than half of the pages of these Institutes, and has been always taught extensively in the Author's Lectures since 1841. In respect to the present work, see, particularly, pages 106 to 111, 283 to 362, and the chapters upon *Remedial Action*, *Therapeutics*, *Counter-Irritation*, *Cathartics*, *Secretion*, and *Excretion*, INDEX II.

Dr. Allen claims, also, the application of the principle to Therapeutics, and remarks that "in my course upon 'General Therapeutics' the subject of 'Counter-Irritation' came under review," and concludes that "the impression MUST BE *transmitted to the nervous centres, and thence reflected to the affected organ. In other words, the influence is primarily exerted upon the cerebro-spinal system, and secondarily upon the internal affected organ.* This is the gist of the whole matter, and the point consists in the recognition of reflex cerebro-spinal action, which, in the instances adduced, give rise to a *molecular* or *integral* change in the inflamed tissue, and not a muscular contraction. The oral elaboration of this principle was suggested by an idea [?] which does not even now appear to have occurred to either M. Hall or Dr. Campbell, viz.: *The motor effect is merely* SECONDARY, *and not a necessary part of the action of the nervous arc.*"

Here, also, the whole of the foregoing doctrine appears throughout these Institutes, but not to the neglect of the *sympathetic nerve.* In the long chapter upon "*Counter-Irritation*" it will be seen that the Author has employed nearly the language of Dr. Allen, as also in that upon "*Remedial Action*," with a great elaboration and extensive application of the doctrine throughout the work; which had been also antecedently taught in his Lectures for seven consecutive years before Dr. Allen promulgated the same views. (*Indexes*, REFLEX ACTION, NERVOUS POWER).

To show still farther this partiality for the Author's Writings, or his Lectures (then familiar to his large classes of students), he will quote from Dr. Allen the following conclusions, which he also places in capitals:

"THE EFFECT IS MOTORY, IF CONTRACTILE FIBRE BE PRESENT.

"THE EFFECT IS SECRETORY, IF SECRETORY ORGANS BE SUPPLIED.

"THE EFFECT IS SENSATION, IF SENSITIVE NEURINE BE REACHED.

"THE EFFECT IS PERCEPTION, OR INTELLECTION, IF THE ORGAN THEREOF BE IN CONNECTION WITH THE REFLEX NERVE."

"*The effect produced, then, depends upon the* STRUCTURE AND CONDITION *of the organ reached.*"

"This influence *is* NOT *confined to the mere increase of action*, as the term EXCITOR might perhaps suggest. The reverse may take place—the excitor may rather become the *depressor.* It would be as correct to say the depressor-motory, the depressor-secretory, as to say the excitor-*idem.*"

Now the Author of these Institutes not only dwells emphatically upon the *depressing* and *sedative* influence of reflex nervous action, according to

the nature of the remote causes and special conditions of disease (§ 224–233¾, 234 *d*, 455 *d–f*, 481, 488½, 500 *c*, *ee*, 503, 514 *b–h*, 516 *d*, no. 13, 526 *d*, 847 *g*, 863 *d*, 891½ *k*, 894–895, 902 *b–m*, 904 *a*, 945, 947, 951 *c*, 966, 973–976, 990½ *a*, *b*), and upon its operation according to the natural structure and special vital constitution of organs, and their varying conditions (p. 59, § 129 *g–i*, p. 61–69, § 132–156, p. 73, § 163, p. 109, § 229, p. 111, § 233¾, p. 285, § 455 *d–f*, p. 313, § 487 *h*, p. 353–362, § 525–529, p. 374–383, § 576–584, p. 415–417, § 649, p. 418, § 651 *b*, p. 421–423, § 657–658, p. 523, § 827 *c*, p. 542, § 854 *bb*, p. 613, § 892½ *b*, p. 644–650, § 893 *c–i*, p. 665–672, § 902–903 *b*, p. 746, § 990½ *b*, and the numerous references in those sections); but the Author represents, also, the reflex action as variously *alterative* in organic life, and this imputed attribute pervades the Author's writings. He enforces, everywhere, the doctrine that the reflex action of the nervous power is the modifying cause through which all the changes are effected by morbific and remedial agents in parts that are not immediately connected with the direct seat of their action; and, farther, that the principle is precisely the same when the nervous power is brought into operation by *direct* influences upon the nervous centres (as in the case of their diseases, or when the Passions operate, or as the Will determines voluntary motion), as it is when it is brought into operation in that indirect manner known as reflex action. Hence he has called the former *direct* nervous action.

Indeed, every one of the foregoing doctrines, in all their particularities, as quoted from the American Claimant, are taught, at great extent, in the volume before us, as may be readily seen by consulting the references made in this protest, and, more extensively, INDEXES, Articles STRUCTURE, NERVOUS POWER, SENSATION, SENSIBILITY, SYMPATHY, ORGANIC FUNCTIONS, REMEDIAL ACTION, MIND, MENTAL EMOTIONS, WILL. —"*Si quæris monumentum, circumspice.*" It may appear superfluous, however, to have made these specific references in an article connected with the work itself; but it is done to encourage those readers who might not otherwise be inclined to ascertain the facts.

But the writer is more interested with the European Umpire, of whom he has felt that he has much more reason to complain.

> "Omne animi vitium tanto conspectus in se
> Crimen habet, quanto major, qui peccat, habetur."—JUVENAL.

That the Author's physiological and medical writings were generally known in Europe many years before the period at which "Dr. Campbell bases his claim" (1850), is evident from the distinguished honors to which they had led in that Country before that period—that from the Medical Society of Prussia as early as 1842—that from the Medical Society of Leipsic in 1843; and the "Medical and Physiological Commentaries" (of 1840) were published simultaneously in London and New York; and as to the United States, the *Commentaries* were early distributed throughout the land, and his *Institutes of Medicine* more than a year, also, before Dr. A.'s Lectures were delivered; and the Author's Lectures at the University, which form the groundwork of his Institutes, had been listened to annually by Medical Students from all quarters of the Union since the year 1841. In 1848 the Author applied the doctrine of reflex nervous action to a physiological demonstration of the substantive existence of the Soul and Instinctive Principle, which was then published in pamphlet form, and in 1849 the work was extended and assumed

the shape of a book, and is now incorporated, in its essential parts, in these Institutes. Also, fully, in Author's *Materia Medica*, 1848, p. 176–180.

Nor is that all; for the whole of this doctrine of reflex nervous action, and of the operation of the nervous power as an *alterative*, an *excitant of the secretions* and of vascular action (both direct and reflex), a *depressant* and *sedative* (according to the nature of exciting causes), and the *great immediate cause of diseases and their cure*—variously modifying organic actions—was set forth extensively and circumstantially in an "*Essay on the* MODUS OPERANDI OF REMEDIES" in 1842, of which the Author distributed, at that time, a large number of copies in London, and addressed four thousand copies to Physicians throughout the United States. The Author not only sent a copy of the work to Dr. Hall, but dedicated it to him (along with Prof. J. Müller and Dr. A. P. W. Philip) in connection with an "*Essay on the Philosophy of Vitality*;" and he may add that he controverted, in the former Essay, doctrines of Dr. Hall (in "*Memoir on Diseases and Derangements of the Nervous System*, 1841"), which were in direct opposition to those which are now in question (also, p. 296–297, § 476½, *b*). These Essays were subsequently bound up in the Third volume of the "*Medical and Physiological Commentaries*," where the former may be readily consulted. But Dr. Philip had fully deduced from his experiments the *sedative* as well as *exciting* influence of the nervous system upon vascular action before Dr. Hall's experiments were made (§ 492)—See *Index II.*—HALL, M.—for many other unpardonable criticisms.

As to M. Bernard, his experiments bearing upon the connection of the nerves with the function of secretion, however much they may have been varied and multiplied, were anticipated long before by those of A. P. W. Philip, which are quoted extensively in these Institutes (p. 290–321), and towards which Dr. Hall had no friendly disposition (p. 306–308, and where the writer has controverted his views). The merit of originality which belongs to the present writer, in relation to these experiments, consists in their extensive application in illustrating the functions of the nervous power as a vital agent, profoundly interested not only as an "excito-secretory" power, and as a modifying cause of all secreted products, nutrition, &c., when diverted from their natural standard, but in deducing from them a universal agency of the reflex action of the nervous system, through "the double nervous arc," in the production and cure of disease, and by which he laboured to explode the chemical and physical doctrines as early as 1840. But, that the writer may not be misapprehended, he will say that he endeavours to establish the fact that secretion in animals, as in plants, is conducted by powers implanted in every part, but that it is constantly influenced physiologically, pathologically, and therapeutically, by reflex action of the nervous system, as also by *direct* action (§ 227, 481).

The writer is very sensible that unaccountable coincidences often present themselves in the development of new thoughts, and in the discovery of hidden things, especially where enduring reputation may be won. "*Ubi mel, ibi apes.*"—"*Uno tiene la fama, y otro carda la lana.*" But the reader, with these Institutes before him, will quickly find that much that is claimed by Dr. Hall, and all that he has granted to Dr. Campbell, in the foregoing quotation, and, therefore, all that Dr. Allen appropriates to himself,* abounds in this volume, and, in fact, constitutes the life and

* "Unus utrique
Error; sed variis illudit partibus."—HORACE.

soul ("ζωή καὶ ψυχή") of the work, as it does, also, of the "*Commentaries*," and of the Essay on the "*Modus Operandi of Remedies*;" nor can the reader fail of the conclusion that, were Dr. Hall's "adjudication," and Dr. Allen's after-thought, founded in any justice, and were not the claimants themselves the obnoxious parties, the present writer would have been long ago convicted by them and by others of arrogant assurance and the grossest plagiarisms. Nevertheless, the Author is most happy to find that his solitary position is becoming relieved, and that a practical direction has been given to his labours by others which cannot fail of carrying forward the great doctrines at which he has toiled, and against manifold obstacles, during his professional life.—NOTE X p. 1127.

New York, September, 1857.

POSTSCRIPT.—From what has been seen in the last preceding Article (which was at first intended for publication without this Postscript), it will not appear remarkable that the Author regards it as a duty to himself and to the cause of that Philosophy in Physiology and other branches of Medicine which he has labored to introduce, that he should set forth the principal details of what he considers himself the unquestionable Author. Prompted, therefore, by these and other obvious reasons, he proceeds to assert his claim of originality to—

1. All that is relative, in principle, to *Reflex Action of the Nervous System* in Pathology and Therapeutics, including the application of antecedent experiments to determine the "Laws of Sympathy" and of the "Vital Functions," as they respect the natural conditions, to all the great problems in those branches of Medicine, so far as the Nervous Influence is involved as a modifying cause; and a systematic *generalization* of the whole subject. The Laws of Reflex Action of the Nervous System, in their Physiological aspect, were understood, to a large extent, as early as the time of Prochaska (§ 463 *b*, 476 *b*), and justice demands of us that analogous contributions by Hippocrates shall be acknowledged (§ 463 *a*), while, also, it will be seen through the foregoing references that this most important subject, in philosophical and practical medicine, had engaged the diligent attention of other eminent observers prior to the grand discovery by Sir Charles Bell of the anatomical media (§ 464, &c.), by the aid of which, and the labors of many others, the great Prussian Physiologist reduced the laws of reflex action of the nervous system to a masterly generalization. The Author of these Institutes had also given his critical attention to the researches of Marshall Hall, and has expressed his opinion of their merits in many places, and summarily in § 463 *b*.

2. The doctrine of *Modification of the Nervous Power* by the Causes which bring it into action, and according to the nature of each Cause, whether mental or physical, remedial or morbific, external and internal, and through which its *Alterative* influences are exerted in conformity with its various modifications, respectively—regarding, therefore, the Nervous Power as a *Vital Alterative Agent* and susceptible of an endless variety of changes in *kind* from the influence of exciting causes; being thus rendered, in its extremes of change, either a vital *stimulant* or *sedative*, exerting *alterative* effects, with corresponding results in both the solids and fluids.—The application of this philosophy equally to the cure and production of diseases in all their gradations. (INDEX I. and II.)

3. The doctrine and demonstration of the operation of *Remedial Agents* and *Morbific Causes* by *Reflex Action of the Nervous System*, as, also,

through the foregoing *modification* of the Nervous Power (No. 2), and all that is relative to the same action in Pathology and Therapeutics.

4. A distinct exposition of the modus operandi of *Counter-Irritants* through *Reflex Action of the Nervous System*, and their associate *local influences;* exemplifying, also, by these agents, the modus operandi of all other agents applied to the skin when they produce constitutional, or any internal effects, whether remedial or morbific—as in the case of cold, mercury, &c. (INDEX II., *Counter-Irritants; Causes, Morbific;* and *Remedies*).

5. A distinct exposition of the modus operandi of the *Seton* through *Reflex Nervous Action and local organic influences*, as exemplifying all the essential philosophy that is ever concerned in the operation of all remedial and morbific agents, as set forth in the Author's Essay on the Modus Operandi of Remedies (1842), and in these Institutes (p. 679–681, § 905 *a*) —being, however, only parallel with the author's demonstration of the operation of Blisters and other Counter-Irritants through the same causations.

6. The operation of *Anæsthetics* through *Reflex Nervous Action*, as contained in this work.

7. Distinction between the agencies of *Reflex Nervous Action* in the modus operandi of the Author's group of *Alteratives* and among other denominations of Remedies (INDEX I. and II.)—an important consideration, by which the *gradual* operation of Remedies through *Reflex Nervous Action* is rendered clearly intelligible, as in the progressive influences of small and frequently repeated doses of tartarized antimony, mercury, &c. (p. 344–345, § 516 *d*, No. 6, 889 *m*, 902 *i–m*, 904 *bb*). And so, also, of the progressive operation of Morbific Causes, either physical or mental—as in hydrophobia, sympathetic diseases, &c. (p. 421–422, § 657 *a*, *b*, p. 465–466, § 715, p. 661–663, § 894–896). The example of the *Seton* illustrates the principle (No. 5).

8. All embraced in this work, and in the Medical and Physiological Commentaries (vol. i., p. 124–384) upon the *Influences and Modus Operandi of* LOSS OF BLOOD (whether in General Bloodletting or Leeching), which are interpreted by the Author upon purely Physiological Laws, and mainly through *Reflex Action of the Nervous System.*

9. The LAW of ADAPTATION, operating through *Reflex Nervous Action* (INDEX I.).

10. The philosophy of the natural operation of the *Will* and *Mental Emotions* through the *direct* development and action of the *Nervous Power*, and its effects as an *Alterative* agent when the latter operates in the cure or production of disease, as embraced in this work.

11. Demonstration of the *direct* development and propagation of the *Nervous Power* as an *Alterative* agent, or a simple *Stimulant* or *Depressant*, in diseases of the nervous centres, &c., and as concerned in Loss of Blood along with *Reflex Action*, &c.

12. What is relative, in this work, to peculiarities of *Structure* in its Vital constitution in different parts (p. 50–73, &c.), and their important bearings upon Physiological, Pathological, and Therapeutical doctrines, as it relates both to the direct action of remedial and morbific causes, and their operation through *Reflex Action of the Nervous System.*

13. The proof and reasoning embraced in these Institutes, and in the Medical and Physiological Commentaries, and other works, in behalf of VITAL SOLIDISM, as applied to Physiology, Pathology, and Therapeutics, and in opposition to the Chemical hypotheses.

14. Special deduction of *Vital Principle*, and peculiar Laws of Organic Beings, from their *Composition*, as embraced in this work (p. 23–49).

15. Special deductions from *Nitrogen Gas*, as contradistinguishing the Organic from the Inorganic Kingdom, as contained in the Essay on the Philosophy of Vitality (1842), and briefly in this work (p. 34–36, § 62 *a–k*).

16. Special deduction of the principles of *Vital Solidism*, Physiological and Pathological, from the development of the incubated *Egg* and the physiology of *Generation*, as contained in the Essay on the Philosophy of Vitality, and in these Institutes (p. 36–49, § 63–81).

17. Analysis and elaboration of the *Properties of Life*, as contained in this work (p. 73–125).

18. The proof adduced in this work, and in the Medical and Physiological Commentaries (vol. i., p. 1–119), of the existence and office of the *Vital Powers* or *Vital Properties*, with a disproof in the latter work of the supposed identity of the Nervous Power and Galvanism, with the variety of proof herein contained of the wonderful attributes of the Nervous Power, as one of the properties of the Vital Principle of Animals.

19. Exposition of Law of *Vital Habit* (p. 363–370, § 535–537).

20. All embraced in these Institutes and the Medical and Physiological Commentaries in disproof of the Chemical and Physical hypotheses as applied to Physiology, Pathology, and Therapeutics.

21. All herein and in the Medical and Physiological Commentaries (vol. i., p. 385–712) in refutation of the *Humoral Pathology*.

22. Demonstration of the dependence of *Digestion* upon Vital Laws, and to the exclusion of the Chemical, as contained in this work and in the Medical and Physiological Commentaries (vol. ii., p. 79–122).

23. Demonstration embraced in these Institutes, and in the Medical and Physiological Commentaries (vol. ii., p. 1–78), of the dependence of *Vegetable* and *Animal Heat* upon Vital Laws, and against the Chemical hypotheses.(p. 236, § 435 *b*).

24. Experiments relative to the *Circulation in the Brain*, showing that the organ is depleted in Bloodletting (p. 824–828).

25. Demonstration of the dependence of *Absorption* and *Circulation* in Plants and Animals upon Vital Laws (p. 817–824, § 1053–1055, and *passim*).

26. Much of what herein relates to the Powers which circulate the Blood, and in the Medical and Physiological Commentaries (vol. ii., p. 398–426).

27. The distinction between *Inflammation* and *Fever*, and what is most essential in proving an active condition of the immediate instruments of Inflammation, and the dependence of its different stages, and of all its phases and products upon Vital Laws, as embraced in these Institutes, and in the Medical and Physiological Commentaries (vol. ii., p. 141–214).

28. All herein relative to the philosophy of *Venous Congestion* and *Varix*, and in Medical and Physiological Commentaries (showing that *venous inflammation* is the pathological condition), and the proof of the dependence of *Tubercle* and *Scrofula* upon Inflammation, and *Cold* as a cause of Congestion, &c., in the several Appendixes to Venous Congestion in Commentaries (vol. ii., p. 215–640).

29. Much of the Physiological bearing of organic changes incident to different periods of Life upon practical medicine (p. 373–383, § 570–584).

30. The uses and abuses of *Morbid Anatomy* as contained in this work and in Medical and Physiological Commentaries (vol. ii., p. 641–677).

31. A generalization of the *mutability of the Properties of Life*, as lying at the foundation of disease and of its cure, and of many natural changes of organization at the different stages of life, of gestation, lactation, &c. Also, the doctrine of a *substitution of pathological conditions* by Remedial Agents, through *reflex nervous action*, more favourable to the law of recuperation than such as had been impressed by the truly morbific causes, and their progressive nature; and the *physiological distinction* which the Author has drawn between remedial and morbific agents.—See *Index* I., Vital Properties.—*Index* II., Remedies; Causes, Morbific; Therapeutics.

32. The demonstration of the operation of *Astringents* upon Vital Principles, and through *reflex action of the nervous system* (p. 370–378).

33. The demonstration of the operation of *Tonics* upon Vital Principles, and through *reflex action of the nervous system* (p. 579–583, § 890½, p. 676–679, § 904 *c*, *d*).

34. Attempted refutation of *Theoretical Geology*, and of *Spontaneity of Being*, to which there are references at p. 908, § 1079 *b*, p. 910–911, § 1083.

35. A critical exposure of the fallacies of the Medical Doctrines embraced in the Writings of P. Ch. A. Louis, in Medical and Physiological Commentaries (vol. ii., p. 679–815, and *passim*).

36. A critical exposure of the fallacies contained in the Writings of Liebig, so far as he has applied Organic Chemistry to Physiology, Pathology, and Therapeutics (p. 147–178, p. 234–279, and *passim*).

37. A *Therapeutical Arrangement of the Materia Medica* upon Physiological principles, and in the order of the relative therapeutical value of the different substances, and as applied to particular forms of disease.

38. All that is relative to the Substantive Existence and Physiology of the Soul and Instinctive Principle, as embraced in this work, and in the former Essay upon those subjects (See Index II, *Note* at p. 873).

39. Opinion that the *Will* exercises a controlling influence upon the *Intestine* in Defecation, and as evincing a remarkable instance of Creative Design, p. 325, § 500, *e*.

Note.—The foregoing specifications appeared in the Fourth Edition of this work, and as the Author has seen no objections alleged that invalidate any of the claims, but rather a general, or at least tacit, admission of them, and as they have been spontaneously republished in several medical periodicals, he leaves them in this Ninth Edition without modification, but will add that, in regard to the term "*excito-secretory function*," although an unimportant matter, and referring simply to the *physiological* condition, he suggested the term itself in sections 514 *h*, 512, 902 *g*, and in many other places; nor will he neglect saying in this connexion that he attempted to show the influence of the sympathetic nerve upon the action of the blood-vessels, and the operation of Counter-Irritants and of Leeching through reflex nervous action as early as the year 1834, in an article in the London *Medico-Chirurgical Review*. See p. 827, § 1056. The author has now taught the doctrines of these Institutes in the Medical Department of the University of the City of New York for twenty-six years.

New York, 1867.

SUPPLEMENT.

[The first paragraph of the section with which this Supplement begins appeared in the Fourth Edition. All that follows belongs to the Fifth.]

CORRELATION OF FORCES.

§ 1085. An important omission was made in that part of our Appendix which relates to the progress of "physiological and pathological chemistry" (p. 779) in not having converted to our purposes the doctrine of the "correlation of forces," to which organic chemistry, in its discomfiture, is now appealing.* This fiction is equivalent to an abandonment of the whole ground to the vital solidist. It is a full acknowledgment that the powers of nature, as they operate in the inorganic world, are entirely inapplicable to living beings, and that the assumption has become necessary that they are transmuted into something very different, but wanting in every other shadow of proof than such as rests upon mere analogies observed in the inorganic world, and without any analogies between organic and inorganic beings. The supposed transmutation is therefore claimed by the vital solidist as his vital principle. But, curiously enough, the chemico-vitalist, in accepting this assumption, contends, also, for a vital principle. Finally, if the vital force be a "transformation of heat," electricity, &c., why is heat, electricity, &c., so conspicuously manifested as such in living beings? Why not altogether converted into the supposed "correlated force?" How will be reconciled with the supposed "metamorphosis of heat into vital force" the prodigious elaboration of *absolute* heat by that organic structure which is said to be the medium through which "heat is transformed into vital force?" Strange function this, which is simultaneously engaged in "transforming heat into vital force" and generating heat under its usual conditions! We suppose that it will scarcely be contended that this sensible caloric is also vital force, notwithstanding its complete submission to the vitalizing power of the whole organic being; or, if this consistency be maintained, the manifestations, by this product of organization, of all the usual effects of caloric, both upon dead and living matter, equally consign the speculation to the same fate as is attending the physical forces in their less mystified application to the science of life (§ 234 *g*, *h*, 350, nos. 16, 17, 19, 20, 21, 37, 376½, 447½, 448).

On different occasions, and sometimes in the course of this work (p. 180–190, § 350¾ *e*–*m*, p. 910–911, §1083), I have shown that it is the tendency of this generalization of organic and inorganic nature to lead to other violations of fundamental laws, of which one of the most glaring is the doctrine of the spontaneity of living beings, and, therefore, a fully implied denial of a Creative Power—by which I mean a Power totally distinct from nature. The latter, it is true, is often obtruding itself under the name of the former; and this, I apprehend, is what is intended to be implied by the common geolog-

* Much of the present work is against the doctrine of "Correlation of Forces." The subject is critically examined in the new edition of my work on the Soul and Instinctive Principle, about to be published, 1870.—See Note Ddd p. 1149.

ical expressions, "the developmental system," and "the progressive development" of living beings, according to their rank in the scale of organization. Sometimes, indeed, this appears to be distinctly avowed, and of which I shall present an example from a late geological work of good repute to show the method in which the doctrine of *chance* is tricked out with the devices of "positive science," but in opposition to its plainest facts and principles. Thus, it is said that,

"We are not told that the *parturitive* powers of the earth, when they first began to be exercised, were very different from what they are now. They may have been more rapid or more slow, but if it was a real physical energy, governed by law, and not merely an arbitrary sign of a contra-natural power, it must, at least, have had a harmony in its workings—such a harmony as would have required that the widely varying among its diversified effects should bear some ratio to the greater strength or longer duration in the cause. It would not have brought out the full-formed, full-grown, and ripened cedar of Lebanon in the same time it required for *giving birth* to the mushroom. *No intimation is given* that the first growth, after the instantaneous starting power, or the utterance of the creative Word, was not as natural as any that followed. We are rather led to believe that this first growth gave the law to all subsequent production. If the first plants or trees did not come from a previous organized seed, the first seeds, at all events, grew out of the plant, and, *as far as the language gives us any idea*, in a similar manner, and by a similar law, and in a corresponding time, or succession of times, to that which regulated any subsequent seeding, or ripening, or fructification of the parent organism." And, again, "There was a *previous nature* in the earth, whether it had been in operation for twenty-four hours or twenty-four thousand years. We may compare this to a stream flowing on and having its regular current of law, or regulated succession of cause and effect. Into this stream we may say there was dropped *a new power—supernatural*, yet not contra-natural, or unnatural—varying the old flow, and raising it to a higher law and a higher energy, yet still in harmony with it. New causations, or new modifications of causation arise, and, after the successions and steps required, be they longer or shorter, a world of vegetation is the result of this chain of causation in the one period, and, through an analogous, if not similar process, an animal creation arose in another."—(*The italics are mine.*)—Professor Tayler Lewis' *Six Days of Creation*, p. 206, 216. 1855.—See, also, Darwin, p. 814, *note.**

Such is the philosophy of the "typical" or "progressive developmental system," or spontaneity of living beings. It is defective, however, in assuming that the same "parturitive powers of the earth" which "gave birth" to the first plants and animals continue to operate now—and it is not true to the Sacred Record in affirming that —"no intimation is given that the first growth after the instantaneous starting power, or the utterance of the creative Word, was not as natural as any that followed," and then explaining away what is affirmed of the first appearance of the vegetable world, where it is most distinctly stated, and in remarkable consistency with the creation of man and animals in a state of maturity, that "the Lord God made the earth and the heavens, and every plant of the field *before it was in the earth*, and every herb of the field *before it grew; for* the Lord

* See Notes P p, page 1142, Q q, page 1145, and *foot-note* at p. 908.

God had not caused it to rain upon the earth, and there was not a man to till the ground;" thus, also, assigning the reasons. The author must, therefore, abide by his own authority. I may finally add that an examination of this subject occurs in my Essay on *Theoretical Geology*, to which reference is made at p. 908, § 1079, *b*.

Organic nature is one of the greatest embarrassments with which modern theoretical geology has been obliged to contend ever since Dr. Buckland discovered that the trilobite is endowed with eyes, and it has, accordingly, undergone many mutations as geologists have become somewhat informed of the laws of living beings. Nevertheless, such is the hidden nature of physiology, and not to be acquired by any extent of anatomical knowledge without a long and laborious study of the phenomena of living beings, and in their morbid as well as natural aspects, the propensity remains to group the organic world under the category of the inorganic. Examples of this nature are common enough, but, to carry out still farther one of the objects of the present section, I shall quote a paragraph from a work by the distinguished Alexander Von Humboldt, who, according to President Edward Everett, "owes his position in the intellectual world to his grasp of the whole domain of science and the majestic range of his generalizations." In his generalization of the forces and phenomena of nature, he undertakes, upon this scheme of philosophy as applicable to inorganic beings, to bring the organic world within the domain of that philosophy, a distinct enunciation of which occurs in his "Aspects of Nature."

"Reflection and continued study in the domains of physiology and chemistry," says this learned man, "have shaken my earlier belief in a peculiar so-called vital force. In 1797, at the close of my work entitled 'Versuche,' etc., I already declared that I by no means regarded the existence of such peculiar vital forces as demonstrated. Since that time I have no longer called peculiar forces what may possibly only be the operation of the concurrent action of the several long-known substances and their material forces." "I have said, in 'Cosmos,' 'The myths of imponderable matter and of *vital forces* peculiar to each organism *have complicated* and *perplexed* the view of nature.'" "Farther on in the same volume I have said, 'In a physical description of the Universe, it should still be noticed that the same substances which compose the organic forms of plants and animals are also found in the inorganic crust of the Globe; and that the same forces or powers which govern inorganic matter are seen to prevail in organic beings likewise, combining and decomposing the various substances, regulating the forms and properties of organic tissues, but acting in these cases *under complicated conditions*, *yet unexpected* [unexplained?], to which the very vague terms of *vital phenomena*, *operation of vital forces*, have been assigned, and which have been systematically grouped according to analogies more or less happily imagined."—p. 408–410.—Also, *Institutes*, p. 272, § 447 *g*.

Such is the opinion of an unusually vigorous mind, and remarkably enriched by an observation of nature; and if it can be of any advantage to the cause which he advocates, it is welcome to it. It is the high authority in science which this philosopher has so justly acquired, and the factitious importance which his opinion of organic life derives from its incorporation in "the majestic range of his general-

izations" that have led, in part, to its introduction here. But it should be considered that Von Humboldt was an unprofessional man, without any recognition as a physiologist in the department of organic nature, and that he was therefore rather less qualified to determine the merits of the question than many others who had made it the great topic of professional life, and least of all, was he entitled to employ his authority in speaking contemptuously of the doctrine which underlies the labours of Haller, John Hunter, Bichat, his own friend John Müller, and, I may add, of every man of note in medicine since the days of Hippocrates. It should, moreover, be considered that this degradation of man and other living beings formed an indispensable element in our Author's plan of the generalization of nature. Without it, *Cosmos* could not have been written. "The view of nature" would have been otherwise too much "perplexed."

Besides the disposition which I have always endeavoured to manifest of affording the physical school of organic nature the opportunity of explaining their philosophy in their own unreserved way, I have also in view, in the present case, my oft-reiterated proof that it is the tendency of this generalization of the forces of nature to conduct its projectors and advocates to still greater violations of physiological laws, since those laws positively enjoin an ascription of the "first origin" of every existing species of animal and plant to a Supreme, Intelligent, Creative Power. But, since this is ignored by the doctrine which I am about to cite, there is necessarily an attendant implication that man and other organic beings were "brought forth," in the language of theoretical geology, "by the parturitive powers of the earth;" or, as explained physiologically, the properties impressed upon matter include a certain number of a vital, "slumbering," nature (§ 135 *d*, 250¾ *a–f*), through which the requisite 17 or 18 elements were assembled together, for every species of animal and plant, which then united them into an almost endless variety of precise ternary, quaternary, &c., compounds, then arranged them into a multitude of complex designs, developed reason and instinct, and ended by enabling man, and all mammiferous animals, and all unfledged birds, to provide sustenance for themselves in their state of infancy (§ 32–57, 350¾ *c*–351, 1082, 1083. Also, INDEX I., Articles, *Composition*, *Structure*, *Life*, *Vitalism and Solidism*, *Design*, *God and Nature*, the original *Essay on* the *Soul and Instinct*, p. 158–172, being an Appendix on the foregoing subject, and the *Essay on Theoretical Geology*, § 1079 *b*).* Here is the intended paragraph from COSMOS, which lets us farther into the philosophy of "positive science:"

"Geographical investigations regarding the ancient seat, the so-called 'cradle of the human race,' are not devoid of a mythical character." Our Author then quotes approvingly from his brother William as follows: "'We do not know, either from history or from authentic tradition, any period of time in which the human race has not been divided into social groups. Whether the *gregarious* condition *was original*, or of subsequent occurrence, *we have no historic evidence to show*. The separate mythical relations found to exist independently of one another in different parts of the earth appear to refute the first hypothesis, and concur in ascribing the generation of the whole human race to the union of one pair. The general prevalence of *this myth* has caused it to be regarded as a traditionary

* I have shown that man, mammiferous animals, and birds, must have been created, *ex necessitate rei*, in a state of maturity both of mind and body.—See NOTE PP p. 1142.

record transmitted from the primitive man to his descendants. But this very circumstance seems rather to prove that it has *no historical foundation*, but has simply arisen from an identity in the mode of intellectual conception, which has everywhere led man to adopt the same conclusion regarding identical phenomena; in the same manner as many myths have doubtlessly arisen, not from any historical connection existing between them, but rather from an identity in human thought and imagination. Another evidence in favour of the *purely mythical nature* of this belief is afforded by the fact that the *first origin* of mankind—a phenomenon which is wholly beyond the sphere of *experience*—is explained in perfect conformity with existing views, being *considered on the principle of the colonization of some desert island or remote mountainous valley at a period when mankind had already existed* for thousands of years. It is in vain that we direct our thoughts to the solution of the *great problem of the first origin*, since man is too intimately associated with his own race and with the relations of time to conceive of the existence of an individual independently of a preceding generation and age. A solution of those difficult questions, which cannot be determined by inductive reasoning or by experience—whether the belief in this presumed traditional condition be actually based on historical evidence, or whether mankind inhabited the earth in gregarious associations from the origin of the race—cannot, therefore, be determined from any philological data, and yet its elucidation ought not to be sought from other sources.' " —*Cosmos*, vol. i., p. 355, Harper's edition.—*My italics* (p. 158, no. $5\frac{1}{2}$).

We may not be surprised, therefore, that our Author's generalization of nature embraces Laplace's doctrine of the evolution of the solar system, and as inculcated in the "Vestiges of Creation" (p. 186, § $350\frac{3}{4}$ *kk*), and now adopted, indeed, by many astronomers. The subject is invested with a certain degree of physiological interest on account of the constitution of the primary rocks, and the analogical reasoning which may be thence carried to the spontaneity of living beings from the assumed evolution of these rocks from a gaseous, chaotic state, exclusively through the properties impressed upon matter. This I have endeavoured to expound in my Essay on Theoretical Geology, and I recur to the subject now for the purpose of showing the harmony with which Cosmos has carried out the generalization of nature, and of giving to its system all the advantages that can inure from such consistency, or, on the other hand, of enabling it to accept, as graciously, the penalties of any defects, and thus subserve, in either case, some of the greatest truths and principles in nature and Religion. The following extract embraces the doctrine: when speaking of the origin of aerolites, he says,

"I would ask why the elementary substances that compose one group of cosmical bodies, or one planetary system, may not, in a great measure, be identical? Why should we not adopt this view, since we may conjecture that these planetary bodies, *like all* the larger or smaller agglomerated masses revolving round the sun, have been thrown off from the once far more expanded solar atmosphere, and been formed from vaporous rings describing their orbits round the central body."—*Cosmos*, vol. i., p. 132.—NOTE PP p. 1142.

It is not now my purpose to discuss the merits of the *Mosaic History* of Creation, as this is not the place, and, moreover, I have done

that in the Essay on Theoretical Geology. But it is appropriate to remark that if the want of "*experience*" disqualifies us for judging of the "first origin of mankind," as intimated in one of the foregoing quotations, and if we do not choose to accept the account of Revelation as "historical," it is highly incumbent upon physiological science to declare that the laws of nature utterly contradict the doctrine that organic beings were evolved by those laws, and that they therefore proclaim their dependence upon an Intelligent, Creative Power. In the former case we have an ample amount of "experience," and if the latter be admitted, all nature ceases at once to be mysterious (§ 4½ *b*), and mystery associates itself with God alone. This doctrine of "experience," it must be allowed, has been carried to the same subject by distinguished physiologists (§ 350¾ *l*), but it is as applicable to all the miracles and prophecies of the Old Testament, and to all the most essential means upon which the authenticity of Christianity depends, as to the origin of mankind; and it would be quite as fatal in science, and even in the ordinary pursuits of man, as it is to Religion. It is even possible that Humboldt would not have won laurels in America had it not been for the inductive philosophy of Columbus. Our Author appropriates in Cosmos the historical facts of the Old Testament so far as they relate to simply human affairs, because it alone informs us of that era of mankind, and this information was important to Cosmos; and herein lies the distinction between that *experience* which is so readily accepted on the mere testimony of man, and that in which man's agency is associated with Divine interposition, till it finally culminates in the distinction between *experience* and *faith* in their abstract relations.* A trust, therefore, in the merely historical facts of the Bible (for our Author has been defended upon this principle), is no proof whatever of a belief in Revelation, or in its Author—no more so than the Jew's trust in the biography of our Lord, as it respects His humanity, is a proof that he is a Christian. It is not unusual, indeed, for the mere Pantheist to employ the term *creator* as a sort of compromise with the Theist, and even to make professions of Christianity. But this has signally failed after the day of novelty, and personal influence, and mutual admiration has ceased, and the authors and actors have passed into history. Injustice is sometimes done, as was remarkably the case with the *Religio-Medici*, for, although it abounds throughout with evidences of the highest order of faith, yet its author incurred the charge of infidelity; and more than fifty years after his death, when time had extinguished animosities, Samuel Johnson thought it necessary to contribute the weight of his mind and character to the just cause of rescuing the Author's memory from this imputation, notwithstanding Browne had made an able defence of himself. But it shows the strong course of reason in its deliberations upon doctrines and professions.

Finally, besides the great question of the identity of the forces and laws of organic and inorganic beings, the remaining object of the present discussion has been equally in behalf of scientific interests, especially physiological; for nothing can be more opposed to the "experience" upon which are founded the facts and principles in physiology than the assumed or implied origin of living beings in the forces which rule the inorganic world; and coming to the intricate, but methodical constitution of the primary rocks, the evidence of a

* He says in a letter to Varnhagen—"Possibly my 'Book of Nature' is not sufficiently Christian for her Majesty," Victoria.—*Letters*, &c.

direct interposition of Creative Power in their formation is as palpable as in living beings, as manifested in the assembling of the numerous elements which compose the crystalline constituents, and in the methodical disposition of the three crystals in the bosom of each other which make up all the granite of the globe; or, if sometimes the three be united with a fourth, or that fourth replace one of the three in other granitic rocks, the same methodical arrangement obtains; all of which, with other characteristics, concur in yielding the same kind of testimony of supernatural dependence as the composition and structure of living objects, however probable it be in the former case that there was a subordinate instrumentality of the forces and laws impressed upon matter; while, also, the nebular hypothesis, and every other shape of the Plutonic doctrine, is absolutely contradicted by the water which enters into the composition of the primary rocks, by the uniform absence of all traces of fusion among the crystals, and especially, also, by the vast differences in temperature at which those crystals, and that water, and the numerous metallic substances, undergo condensation, besides an array of other facts whose introduction here would be inappropriate, but which I have considered extensively in the Essay on Theoretical Geology. Here, therefore, is something for the senses, something from "experience," something demonstrable through the established facts and laws in chemistry and physics. Still, however, it is certainly to be expected that all who neglect the facts which declare the "first origin" of man and other living beings in an Intelligent, Creative Power, and refer their origin to the powers of nature, will unhesitatingly ignore the corresponding facts in their relation to the earth, and assemble the whole under a common generalization. A critical attention, also, to the writings of those who sustain the nebular hypothesis will result in the conviction that they are equally pledged to the doctrine of the evolution of organic nature through the powers alone which appertain to matter.

Science, for its own sake, especially physiological science, should be consistent with itself. Nor may we exclude from the interests of the latter the cosmogony of the nebular hypothesis, for, as I have shown, such is the elementary composition of the primary rocks (seven elements for feldspar, ten for mica, and which, according to the nebular hypothesis, must have existed, along with all other terrestrial things, in a perfectly blended condition), and such the uniformity and arrangement of the crystalline substances, and such, therefore, the ground for analogical reasoning, that were it conceded that the main bulk of the earth was brought into its organized condition by its own properties alone, it would be a vain attempt to refute the doctrine of the spontaneity of living beings by any demonstrations founded on their elementary composition and constituent parts. To assume, as does the nebular hypothesis, and that of the spontaneity of living beings, that the elements of matter were endowed with the independent power of generating their organized conditions, is so contrary to all experience (for the artificial production of crystals, or as witnessed in natural progress, bears no proper analogy to the complexity of the primary rocks), that it supposes a condition of things which is equivalent to Creative Energy. It is an illusion, therefore, to imagine that science divests itself of causes that elude its ambitious grasp by assuming that "blind material forces" will explain the origin

of both living beings and the primary crystalline rocks, since, in either case, it demands a condition of forces and laws which experience assures us, and science admits, does not exist at present; or, if it be content with a simple expression of ignorance of the organizing causes, from "want of experience," it is equally an admission that terrestrial beings originated in causes which have no existence now, and therefore not belonging to the constitution of nature. The plea of a "want of experience" simply means that the causes which gave origin to organic nature and the primary rocks ceased their operation before the observations of men began. They have therefore no longer an existence; otherwise, they would continue to operate, and new animals and plants, if not granitic rocks, &c., would be presenting themselves. Science, therefore, in separating from Supernatural Power convicts itself of inconsistency; and the essential difference between the supposed "parturitive power," and the co-operation of Divine Power with the properties impressed upon matter, in expounding the problem before us, whether it respect the organization of the earth or of living beings, consists in the neglect, in the former case, of all the evidences of Design, and in a disposition to lean upon the atheism of pantheism. But this in no respect compasses the abstract object of the disciples of nature, for there still remains the crushing fact that it is contrary to all "experience," to all that is known of nature, to suppose that living beings, or the primitive earth, emerged from the elements of matter without at the same time supposing that some supernatural agency was concerned in the works. In the one case, therefore, science stultifies itself, while, in yielding to the agency of an Intelligent Creative Power, it simply obeys the exigencies of the facts and the dictates of that reason which professes to be a rude imitator of some of the Designs which challenge its faith in a higher order of Reason (§ 350¾ *f–i*, *l*, 1079 *b*, 1083).*

The Glycogenic Function of the Liver.

§ 1086. Among the subjects discussed in the Appendix to this work is the important one of the supposed glycogenic function of the liver. Had this anomalous complication of functions, with all its other attendant peculiarities, been attributed to the liver only, it would have been more difficult to have arrived at the real facts in the case. But the discoverer has recently not a little invalidated the plausible experiments which had conducted him to his conclusions by assigning this same function to the placenta "during the early period of fœtal life." This appears to have been a kind of corollary from the imputed function of the fully-developed liver and its immaturity during the early period of fœtal life, but resting upon experimental observation. That such a coincidence should exist between two organs so differently constituted, and whose principal offices are so dissimilar in the economy of life, may well raise our admiration; and this the more so, as the glycogenic function of the placenta is said to disappear, along with its special anatomical provision, as soon as the fœtal liver has advanced to a maturer development. Nature, therefore, to be consistent in this remarkable scheme, should have allotted, also, to "the transitory glandular or epithelial element of the placenta," as to the mature liver, the vicarious function of secreting bile; and hence, should the glycogenic function be established, and

* See NOTES PP p. 1142, QQ p. 1145.

the exact disappearance of the glandular element when it is no longer necessary to the exigencies of fœtal life, we may expect to hear from the eminent physiologist that he has demonstrated the co-existence of the two hepatic functions in the placenta. But the original supposition relative to the liver was apparently encumbered with difficulties, as was shown in sections 1031–1033, and the "vicarious" nature of the supposed temporary office of the placenta would seem to belong to the category of the "vicarious spermatozoa," as represented in section 83 *b*, or to what is perhaps more analogous in § 493 *c*.

The Cause of the Blood's Fluidity.

§ 1087. It was a very ingenious, and so far as appearances went, a plausible demonstration of Dr. Richardson's, in his prize essay, that the blood owes its fluidity to the presence of ammonia. This is a question, however, not to be determined by chemical experiments, or by any other outside of the living body. If experiments with pepsin, or the "digestive mixture," could not stand the test of organic philosophy, nor even of experimental philosophy (p. 781, § 1029), it was scarcely probable that those would long endure by which the new doctrine of the blood's fluidity was very plausibly commended to the attention of the physiological world; and the only apparent objection about it was, that it did not insist that the heart and blood-vessels are stimulated into action by the solvent principle of the blood. It may have been foreseen that such a theory would imply great fluctuations beyond the standard frequency of the pulse, according to the variable proportions of ammonia. But it is at least certain that, whenever such experiments have been attempted upon this organic, living, complex fluid, whatever their nature, they have been shown to be fallacious, and such has been the early fate of this new hypothesis in the hands of Brück and Zimmermann, the former particularly sustaining the Hunterian theory that the fluidity is owing to a vivifying influence exerted upon the blood by the sanguiferous organs, while the latter very justly supposes that the coagulation of abstracted blood is due to chemical transformations. These transformations are prevented, while the blood is circulating, by the influences of the blood-vessels which maintain its vitality. When those influences are withdrawn, the oxygen and other elements of the fluid pass very quickly under the operation of chemical affinities, as set forth in section 54 *a*. I may finally add that, when the various characteristics of the blood, such of them as are represented in many parts of this work, as in sections 688 *ee*, 846, 847, 952, 953, are duly considered, it must be admitted that such phenomena evince the dependence of the blood's fluidity upon a cause appertaining to the constitution of the blood itself, while other obvious considerations place it beyond doubt that so important a condition of the *pabulum vitæ* is not committed to the physical action of any one of its constantly-fluctuating constituents; for if ammonia be truly one of them, it must be as liable to variations, at least in proportions, as the serum, globules, etc., and the fluidity of the blood, therefore, exposed to the same instability. Richardson's clever observations have been accepted by other physiologists; but they are a part of the "experimental philosophy" of the day, whose factitious analogies have been so extensively and powerfully arrayed

against the great laws of organic beings, and the subject is introduced here as tributary to the objects of these Institutes.—See HUMORAL PATHOLOGY, *Index II.*

THE MODUS OPERANDI OF REMEDIES.

§ 1088 *a.* As principles and sound analogy, the great ends of science and the basis of the healing art, are of very secondary moment with the speculative as well as the practical masses of mankind, a demand is apt to be made for specific demonstrations of every problem that may arise in the vast range of observation. It is not enough, for example, that it be shown of a thousand things that they exert their morbific or remedial effects through natural physiological laws, and that when their influences extend to parts remote from the seat of their application it is through the medium of the nervous system. Each particular fact must be settled experimentally as if it had no law governing its condition. This propensity must be gratified, and it will doubtless end, also, in satisfying all that organic nature is perfectly consistent, throughout its mutations, in all its laws and principles.

The foregoing considerations lead me into a farther proof that certain substances, particularly arsenic and strychnine, which are supposed to exert their effects by absorption, have been again shown to be incapable of detection within the organism when administered in poisonous doses. Two cases of this nature, where large quantities of strychnine (two scruples in one of them), and six experiments upon animals by poisoning with the same substance, are related by Dr. Alfred S. Taylor in Guy's Hospital Reports (1856, vol. ii), in which none of the poison could be detected in the blood or tissues. Another case is related in the same Reports (1857, vol. iii), in which Prof. Christison, and Dr. Maclagan of Edinburgh, and Prof. Geoghegan of Dublin, to whom parts of the body were sent, and Dr. Taylor, failed of detecting the poison. Here occurs, also, the case of Rev. Dr. Alexander, who died from poisoning by arsenic, but in whom none of the metal could be found.

Absorption by the Skin.

§ 1088 *b.* Experiments, also, showing that the *skin* in its natural condition absorbs nothing, even in a state of solution, continue to be multiplied; and yet we are constantly told in the books that remedies applied to this organ produce their effects by absorption into the circulation. Let us have, therefore, some of the late, reiterated experiments in reference to this question. Thus, it is stated in the report on Physiology in the London *Medico-Chirurgical Review* for Jan., 1857, that,

"The inferences regarding the absorption of saline or organic substances dissolved in water (in Duriau's experiments with the warm bath) are based on the examination of the urine before and after the use of the bath. Iodine and ferrocyanide of potassium, carbonate of potash, sulphate of quinia, and other salts, were employed. The reaction of the urine after the bath was always alkaline, even when *nitric acid* had been added to the bath. Potash and soda were the only bases found in the urine—no trace of iodine, cyanogen, &c.

"Poulet draws the following inferences from his experiments: 1.

That the urine becomes alkaline after acid, as well as after alkaline baths. 2. After friction of the skin with a solution of tartrate of antimony or extract of belladonna, &c., none of these substances were found in the urine. 3. The skin absorbs, therefore, neither water (?) nor substances dissolved in it, as long as the epidermis is entire.

"Kletzinsky's experiments likewise confirm the non-absorption of salts through the healthy epidermis."—See *Index II.*, Articles HUMORAL PATHOLOGY, SKIN, COLD, COUNTER-IRRITANTS, SETON, PLASTERS, REMEDIES. Also, *Experiments*, § 481–484, 494 *b–e*,

§ 1088 *c*. It is worthy of remark, however, that experiments of the foregoing negative character have little influence upon doctrines of so much simplicity, and of such comprehensive and ready application in pathology and therapeutics as humoralism and the operation of remedies by absorption. It therefore continues, as ever, to be a prevailing belief that, among other things, the numerous preparations of mercury are absorbed both by the skin and the intestinal canal, and, entering the circulation, not only thus accomplish their effects, but become deposited in the tissues (§ 851). Thus lodged in the system, they are supposed to inflict the manifold evils that are due to vicious habits, or other foreign causes. But the most curious circumstance attending this hypothesis, and which must not be omitted in this record of "experimental philosophy," a practice has obtained extensively of immersing these subjects in iodine baths, for the purpose of dislodging the supposed offender. But the facts being against the philosophy, at least as it respects the skin, and as iodine baths have been said to effect the liberation of mercury from the system at long intervals after the administration of the latter remedy, we may safely conclude that what has been asserted by Professor Lorinser, and others, of a similar effect by the internal use of iodine, is equally a mistake, especially when connected with the various facts which I have alleged against the supposed absorption of mercury.

Nevertheless, it may be said that negative facts cannot contradict the affirmative. But, in the first place, are the affirmative reliable (§ 5¼–6)? Are not the senses apt to be deceived by preconceived hypotheses? Why, if many remedies of a very irritating nature operate by absorption, do they not manifest their action upon the heart as readily as upon organs that are incomparably less irritable (§ 829)? Is not this consideration alone an insuperable objection to the hypothesis of absorption? If it be answered that reflex actions of the nervous system excited by remedial agents should, in conformity with the principles which I have advanced, be equally liable to affect the heart, it would only evince an ignorance of the most obvious laws of the nervous system, and which, in this aspect of their remarkable characteristics, I have endeavoured to illustrate in former sections (§ 233¾; 500 *j*, *k*, *m*, &c.). The wonderful endowment of the nervous system by which it receives and reflects impressions upon particular parts and avoids all other parts, according to the nature of the exciting cause and other special circumstances, readily explains, and can alone explain, the phenomenon in question, especially considering its remarkable frequency. And here I may add to what I have said of the operation of anæsthetics through reflex action of the nervous system, that the law of elective influence (§ 233¾, 500 *j*, *k*, &c.) explains completely the limitation of their effects to the organs of animal life, while

the doctrine of absorption is contradicted by that limitation (§ 827 *b*, 1066), as is the doctrine in its broadest sense by local diseases.

Finally, the foregoing negative observations (§ 1088 *a*, *b*) are as good, at least, as the affirmative; and since, therefore, it is thus shown that many remedies that have been supposed to always operate by absorption do sometimes produce their effects upon various parts without being taken into the circulation, and therefore by no other conceivable method than that which I have indicated, the consistency of the laws of nature is such as to assure us that the same remedies always exert their effects upon parts remote from their seat of application through alterative influences of reflex action of the nervous system, and that, if they be sometimes absorbed, the present and foregoing considerations, as well as a multitude of others which occur in this work, equally assure us that they are admitted in such small quantities as to produce no effect whatever, not even upon the very irritable heart. (See *Index II.*, Articles REMEDIES, REFLEX ACTION, NERVOUS POWER, &c.)—NOTE AAA p. 1146.

Transfusion of Remedies into the Circulation.

§ 1088. *d.* The foregoing sections upon absorption will remind some of our readers of an experiment performed a few years ago by Prof. Buckheim, of injecting a solution of about half an ounce of sulphate of soda in two ounces of water into the jugular vein of two dogs without any effect upon the intestine, while both animals were purged freely by the same dose when administered by the mouth. The demonstration is, of course, conclusive against the prevailing doctrine of operation of cathartics by absorption, and proves that they exert their direct effects upon the mucous coat of the intestine, and by reflex action of the nervous system upon the muscular coat, and upon all other parts that may feel their influence. In the present case there is not only the assurance arising from the failure of the injected substance to excite the slightest action in the intestinal canal, but the interpretation supplied by the exciting effect of the nervous influence when reflected upon the intestinal muscular tissue through the direct irritation of the mucous when the cathartic was swallowed; since, no action being manifested in the case of the injection, all the results from swallowing the agent must, of necessity, be referred to the same causation that increased the peristaltic movements (§ 889 *a*). But these are facts which lie in the depths of philosophical medicine. To be duly appreciated there must have been a laborious study of the profound laws in physiology, especially such as are relative to the nervous system in its connection with organic functions. In any event, the experiments cannot fail of establishing the conviction that remedies do not operate by absorption, and sustain my conclusions as to the fallacious nature of this kind of "experimental philosophy" (§ 830–837). Also, *Index II.*, Articles, CATHARTICS; OIL, CASTOR; HUMORAL PATHOLOGY.)

Absorption through the Epithelial Cells of the Intestinal Tube, and Lacteal Circulation.

§ 1089. The following observations, so far as they go, corroborate the doctrines in this work (§ 275–294, &c.), and in the Medical and Physiological Commentaries, upon the subject of endosmose and ex-

osmose, and more particularly the manner in which substances are taken up by the absorbents.

"Von Wittich," says the London Medico-Chirurgical Review for July, 1857, "contributes an observation of great importance regarding the question at issue (the passage of solid molecules through the epithelial cells of the intestinal tube). A rabbit killed (by bleeding) six hours after it had been bitten in the back by a dog, and thus deprived of the use of his posterior limbs, exhibited the chyliferous vessels originating from the lower half of the ileum filled with an entirely red fluid. This redness was shown to be caused merely by the admixture of the red blood-globules in a large proportion, not by that of coloring matter. The corresponding part of the intestinal tube contained mucus mixed with blood, after the removal of which the mucous membrane manifested the appearance of fine red dots, which, by means of a lens, were recognized as villi filled with blood. Von Wittich does not hesitate to explain this state of things by adopting the view, that the blood-globules pass as such through the epithelial cells and the parenchyma of the villi into the chyliferous vessels; but is of a similar opinion regarding the entrance of fat and other minutely divided solid substances into the absorbent vessels." He found the same true, also, of the chyliferous vessels of the cæcum.

The foregoing observations had been recently made by others, one of whom I shall quote upon the particular question, for the sake of other facts, as related in the *Med. Chir. Rev.* for January, 1854.

"Brücke states, as the result of his observations and experiments (on man, swine, and other mammalia), that the cylindrical epithelial cells of the mucous membrane of the intestines, through which the chyle passes on its way to the lacteal vessels, do not, as is generally supposed, consist of *a closed cavity* surrounded by a complete membrane, but that this cavity is isolated from the intestinal tube merely by a thin layer of a mucilaginous substance. Brücke asserts also that they possess a small *opening* on their opposite side, through which the molecules of fat pass into the interior of the villi" (§ 295). And he goes so far as to say that one of "the mechanical means for the movement of the chyle is the muscular contractions of the intestinal tube by which the chyle is pressed into the villi." Why not, then, other things "pressed in;" and is not the analogy supplied by plants of some application here? (§ 289–291, p. 166, § 350, nos. 26½, 27, the *parallel columns*, 826 *a*.) It is an important and sound conclusion, however, and in which Von Wittich and Moleschott agree with Brücke, in opposition to the prevailing doctrine (§ 1054–1055), that, "When the villi are filled, their muscular fibres contract, and the fluid they contain is pressed into the channels lying between the mucous and submucous membranes," and that, "from the lacteals within the walls of the intestines the chyle is propelled by means of the muscular contractions of the tubes into the vessels of the mesentery, from whence it is pumped up by means of the respiratory actions into the thoracic duct;" or rather, as I have endeavoured to show, "pumped up" by the derivative or suction power of the right cavities of the heart. (*Indexes*, CIRCULATION OF THE BLOOD, LACTEALS, VEINS.)

In all the discussions upon the foregoing subject we hear nothing of the intestinal veins being concerned in the function of absorption,

although this is as much a matter of general belief as in Magendie's day (269, 829).

Doubtless, the essential fact relative to the intestinal villi was well ascertained by Mr. Cruikshank, in the presence of Mr. Hunter, whose statement I quoted in the *Med. and Physiolog. Comm.* (1840), that they had seen the villi distended with chyle, and had no difficulty in seeing the open orifices. I shall also repeat here, for pathological as well as physiological purposes, a quotation which I made, in the article upon *Endosmose* and *Exosmose* (vol. i.), from R. Jackson on *Febrile Diseases.* Thus: "R. Jackson, in speaking of the enlarged blood-vessels of the villous coat of the intestines (in yellow fever), remarks that 'in some instances the *mouths* of the canals were visible at *different points* in the interior surface, yielding a dark-coloured fluid by pressure.' Again: 'The mouths of ducts—not blood-vessels—were discovered on the interior of the colon, containing a dark-coloured fluid.' 'Proceeding farther with the investigation, similar canals discharging a tar-like fluid into the interior of the stomach, more especially near the upper orifice, were in like manner discovered *in almost all cases* where black vomiting had been a conspicuous symptom of the disease. The appearances were noted, and they were often verified by inspection.' As to the open termination of the villi, we are not insensible of our solitary position, since it is stated in the *British and Foreign Med. Review* that 'almost every modern physiologist has now abandoned the idea that the absorbents commence by open mouths on the villous coat of the intestines.' This opinion we are certainly bound to respect so far as it is supported by any facts, or is not contradicted by others."—*Medical and Physiological Commentaries, ut supra.*—Also, *Institutes* § 275.

The Forces which Circulate the Blood.

§ 1090. The following quotation is made from the *British and Foreign Med. Chirurg. Review* of January, 1859, simply for the reason that it sustains several of the principal conclusions set forth in this work, and originally in the *Medical and Physiological Commentaries* upon the important subject of the forces by which the blood is circulated. See *Index II.*, article *Circulation of the Blood.*

"Nelson considers the diastole of the heart as the effect of an active movement. He assumes that the heart muscles, unlike voluntary muscles, are possessed of a double power—that of expansion as well as of contraction. The distention of the ventricles, the Author says, 'is an active and inherent force.' The mechanical forces acting on the movement of the blood in the veins are: 1. That furnished by the heart and arteries; 2. That by the pleural vacuum of the thorax; and, 3. The expansive power of the auricle." These, however, are only a part of the forces concerned, nor do I suppose that the expansion of the thorax is much of an element, as I endeavoured to show in the *Medical and Physiological Commentaries.*

As to Oesterreicher's old experiment of placing a heavy weight upon the heart of a frog and deducing from it the important conclusion that the dilatation of the organ is not an active movement, and which continues to be quoted as an unquestioned authority, I show in the *Commentaries* that the experiment proves exactly the contrary.—*Med. and Physiolog. Comm.*, vol. ii., p. 399–402. Also, NOTE BB p. 1131.

New York, 1859.

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* "About *thirty* Medical Schools in the United States, in which there is probably an annual average of 4500 students, 1300 of whom are yearly graduated. (Population, 20,000,000.) In France with a population of 35,000,000, there are but *three* Medical Schools, which graduate only about 700 annually!"—*Boston Medical and Surgical Journal*, Dec 2, 1846, p. 365.

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in producing inflammation of the bladder without injuring the stomach, and as the stomach may subsequently become

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demonstrate, like Arsenic, Tartarized Antimony, Iodine, &c., the modus operandi of remedial and morbific agents through alterative influence of reflex nervous action, and the fallacy of the doctrine of absorption, and how remedies operate by that medium through increased susceptibility of parts morbidly affected, and according to peculiarities in the natural constitution of tissues, and how they prove remedial or morbific according to their just application, and upon a common principle—by the failure of the vesicating plaster to affect any internal organ in its healthy state excepting the *bladder*, while it will overthrow inflammations of all other internal parts, or will aggravate the same disease if not duly applied, but will exert no such effects when administered internally excepting upon the bladder. See *last preceding references.* Also, § 1059, 1088.
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all may operate upon internal parts through alterative influence of reflex action of nervous system; but many of them are commonly local only in their effects. Whenever they exceed the limit of local action, it is through reflex nervous influence, and this influence, especially in the case of vesicants, instead of being curative, may produce or aggravate disease, according to existing susceptibilities and the natural endowment of tissues and organs, and throw the whole body into universal commotion—by which is exemplified the close analogy between remedial and morbific agents, and, as demonstrated (articles *Cantharides*, *Seton*, *Cold*, &c., *Index II.*), that remedies do not operate by absorption, but through alterative action of the nervous influence, and according to the nature of the remedy or mental emotion and the existing susceptibilities of organs that may arise from disease, &c, p. 338, § 514 *d*; p. 359–360, § 527 *b*; p. 592, § 891½ *g*; p. 642–659, § 893 *a–q*; p. 679–681, § 905 *a*; p. 850, § 1059; § 1088. Reflex Action of Nervous System, Remedies; Causes, Morbific; Mental Emotions, Structure, *Index II.*; Nervous Power, *Index I. and II.*
introductory review of problems relative to the operation of other remedies through alterative action of reflex nervous influence to facilitate an understanding of the same modus operandi of Counter-Irritants, which opens widely a view of the Author's principles relative to vital solidism, and direct and reflex action of the nervous system in the production and cure of disease, p. 645–646, § 893 *c*, *d*.
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the artificial inflammation produced by the vesicating plaster either in the skin or the bladder readily subsides, and thus, also, through its development and modification of reflex nervous influence, it institutes such pathological changes in diseased internal organs as to lead to their speedy cure—thus illustrating the morbific nature of positive remedial action and its distinction from the effects of more profoundly morbific causes, that remedies cure by substituting new and transitory pathological conditions, and the great recuperative law of Nature; and which is farther shown by the manner in which the plaster of Cantharides will arrest erysipelas, and the oil of turpentine relieve scalds, p. 646–647, § 893 *c–e*; p. 652, § 893 *l*; p. 682, § 905 *b*.
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along with the laws of reflex action of the nervous system, by which all are maintained in one everlasting harmony of functions, constitutes a more sublime edifice of Design than all else in the world of matter, p. 146, § 326. Also, p. 54–55, § 107–117; p. 106–112, § 222–234 *b;* p. 284–287, § 454–458.
physiology of assimilation applied pathologically—gastric juice changed by gastric disease, which, as well as the influence of the disease, affects the condition of the blood, though Chemistry cannot tell us how; and Humoralism defeated in practice, the Vital Solidist resolves the problem and demonstrates the art of making healthy blood, p 146–147, § 328–330; p. 534–537, § 845–847 *c;* p. 540, § 851 *b;* p. 780, § 1029; Note R p. 1123.
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depends also upon the natural constitution of parts. See Causes, Morbific, first subdivision, *Index II.*
produced and cured by Mental Emotions through direct development of nervous influence. See Mental Emotions, Remedial Action, *subdivision* Mental Emotions, and Nervous Power, *Index II.*
disease of one part becomes the cause of disease in another part through alterative influence of reflex nervous action; and disease of one part supervening as a sympathetic result in another part may reflect, after the manner of Counter-Irritants, through reflex action of nervous system, a salubrious influence upon the primary affection, p. 340, § 514 *h;* p. 351–352, § 524 *c;* p. 679–681, § 905 *a;* also, Counter-Irritants, *Index II.*
—but which art cannot imitate by internal remedies, though attempted, p. 654–656, § 893 *n;* p. 856–861, § 1063 *b*–1065—or, as it subsides in the secondary affection, it may again
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analysis of a case of fever, complicated with inflammations and venous congestions, showing how to investigate disease, and trace out the consecutive derangements that are superinduced by morbific influences of reflex nervous action, p. 438–442, § 686 *b–d.* Also, Symptoms, *Index II.*
important in leading to a knowledge of physiological states and of the properties and laws of organic beings, p. 265, § 447 *b;* p. 413, § 639 *b;* p. 798, § 1034, and *references* there.
Diseases, Self-limited,
illustrate the recuperative tendency of Nature, and the uses of remedies, p. 544–545, § 858.
treatment of, mostly expectant, but when complicated with local inflammation the constitutional affection is so brought under their influence, through reflex action of nervous system, as to admit of active treatment, p. 59, § 127 *h, i;* p. 61, § 134; p. 63, § 137 *b, c;* p. 65, § 143 *c;* p. 67–68, § 149–152; p. 69, § 156 *b;* p. 73, § 163; p. 430–433, § 675–676 *a;* p. 508–509, § 809–811; p. 531, § 839; p. 538, § 847 *g, h;* p. 539, § 848; p. 544–545, § 858; p. 553, § 870 *aa;* p. 597–599, § 892 *c, d;* p. 732, § 970 *c;* p. 733–736, § 973 *b*–980. Also, Law of Adaptation, *Index I.*
their causes impress a curative disposition which cannot be improved by remedial agents; thus showing also, as in the case of Counter-Irritants, the principle upon which remedies operate, p. 531, § 839; p. 544–545, § 858, 861. Also, Counter-Irritants, Cantharides, *Index II.*
the principle through which their causes extinguish the susceptibility of the system to their repeated operation is the same as involved in acclimation, with the difference that the acclimated must continue to live under the influence of the morbific causes, or the susceptibility to their action will return, p. 364, § 543–548; p. 421, § 654 *b;* p. 425, § 664. Also, p. 170–173, Nos. 40–45, *parallel columns.*
Disgust,
determines vomiting by first propagat-

Disgust—*continued.*
ing the nervous influence upon the mucous coat of the stomach, upon which it acts after the manner of emetics, when the process of reflex nervous action is instituted as in the case of emetics; and when vomiting arises from tickling the throat, or a fall, or sailing, &c., it is the result of a double process of reflex action of nervous system, but is otherwise like that from *disgust*—and employed by the Author to interpret the modus operandi of remedial and morbific causes, physical and mental, through direct or reflex action of the nervous system, and to illustrate the substantive existence and self-acting nature of the Soul, p. 324–328, § 500 *c–dd, k;* p. 340, § 514 *k–m;* p. 547–550, § 863 *d;* p. 889–890, § 1077. Also, Joy and Anger, Love, Grief, Fear, Jealousy, Hope, Shame, Yawning, Sneezing, Sea-Sickness, Mental Emotions, Reflex Action of Nervous System, Remedial Action, *subdivision* Mental Emotions, *Index II.;* Nervous Power, *Ind. I. and II.*

Distribution. See Circulation.

Diuretics,
proper, are feebly endowed with curative virtues; while other and the most useful means for dropsy, such as bloodletting, cathartics, may be far more diuretic through their profound influences upon disease; by which, also, is illustrated the inflammatory nature of dropsical affections, p. 630–633, § 892¾. Also, p. 364, § 545; p. 419–420, § 653; p. 421, § 654 *b;* p. 563–564, § 889 *a, b;* p. 665–669, § 902 *a–i;* and Iodine, *Index II.*
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Dysentery,
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E.

Elaterium,
employed, along with other cathartics, to illustrate the doctrine of *revulsion*, through its profound development of a morbific reflex nervous influence, and the misapplication of Cathartics upon the principle of counter-irritation, p. 655–656, § 893 *n;* p. 722, § 960 *g;* p. 856–862, § 1063–1065.

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their therapeutical as well as physiological effects take place through reflex action of the nervous system, the latter of which, like the increased peristaltic action arising from cathartics, is a simple concurring element of other alterative influences of the same action reflected upon other parts rendered susceptible by disease, p. 107–110, § 227–230; p. 323–324, § 500 *c;* p. 326–328, § 500 *h–k;* p. 333, § 504; p. 336–337, § 514 *a–c;* p. 532–533, § 841; p. 547–550, § 863 *d;* p. 661–663, § 894–896; p. 666–669, § 902 *c–i;* p. 675–676, § 904 *bb;* p. 876–877, § 1072 *a;* p. 879–880, § 1074; p. 886–891, § 1077. Also, Ipecac., *Ind. II.*
modify the reflex action of the nervous system according to the nature of the exciting cause, whether physical or mental, and upon which modification the special nature of the alterative influences depends, p. 547–550, § 863 *d;* p. 664, § 900; p. 667–669, § 902 *e–i.* Also, *preceding references*, and Alteratives, Cathartics, Disgust, Sea-Sickness, Mental Emotions, Remedial Action, *subdivision* Mental Emotions, *Index II.;* Nervous Power, *Index I. and II.*

Emmenagogues,
arranged in the Author's Therapeutical System of the Materia Medica under the general denomination of Uterine Agents, which are distinguished by a variety of virtues in relation to the uterine system in its morbid or preternatural states, p. 628, § 892¾ *q;* p. 684–687, § 895½ *b.*
inadmissible in inflammatory and irritable states of the uterus, *ibid.*
amenorrhœa apt to be a sympathetic consequence of abdominal derange-

Emmenagogues—*continued.*
ments, and maintained by them; but this morbific effect of reflex nervous influence is also apt to be overlooked, and the uterine affection to be regarded as the principal malady, while the evils that may arise immediately from the latter, though comparatively unimportant, depend mostly upon its morbid disturbance, and little upon the failure of the discharge, p. 233–234, § 428–432; p. 628–629, § 892⅔ *r*; p. 684–687, § 895½ *b*.
remedies should be addressed to the primary derangements, while, also, emmenagogues may or may not be expedient, but probably means of a local nature—so that a variety of treatment is necessary in the multifarious conditions attending amenorrhœa, p. 545, § 859 *b*, and *references* there; p. 616–617, § 892½ *f*, *k*; p. 628–629, § 892⅔ *r–t*; p. 684–687, § 895½ *b*. Also, Amenorrhœa, *Index II.*

Emotions. See Mental Emotions, Remedial Action, *subdivision* Mental Emotions, Joy and Anger, Grief, Hope, Love, Disgust, Fear, Jealousy, Shame, *Index II.*

Endermic Remedies. See Remedies, Endermic, *Index II.*

Endosmosis—continued from *Index I.*, admitted to be sustained only by "scanty facts," p. 797, § 1034. Also, Anæsthetics, *Index II*

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Epispastics. See Counter-Irritants, *Index II.*

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its primary action upon the stomach,

Ergot—*continued.*
and, through reflex nervous influence, upon the uterus—illustrative of the modus operandi of all remedial and morbific agents—and its reputed deleterious effects upon the nervous centres by absorption due to other causes, generally to reflected nervous influence excited by the uterus and determined with violence upon those centres, p. 623, § 892⅔ *c*; p. 626–627, § 892⅔ *l*. Also, Epilepsy, Antispasmodics, Nervous Power, *Index II.*
excites the uterus in its impregnated state to contraction in numerous animals, as well as the human subject, p. 624, § 892⅔ *d*—but only then, and often fails unless parturition has begun, or when the organ is rendered susceptible by morbid states, as in cases of hydatids and menorrhagia, showing, like numerous other things, the mutability of the properties of life, and, like Arsenic, Iodine, Tartarized Antimony, that the action of remedies depends greatly upon a morbidly increased susceptibility of the parts diseased, and that no safe conclusions can be drawn from experiments with remedies upon healthy subjects as to their influences upon morbid states, *ibid.* Also, Arsenic, Remedies, Alteratives, Reflex Action of Nervous System, *Index II.*; Nervous Power, *Index I. and II.*
reasons for thinking it not reliable for producing abortion, p. 624–625, § 892⅔ *d*.
circumstances under which its use is desirable or admissible in cases of labor, p. 620–622, § 892⅔ *a*, *b*; p. 625–627, § 892 *f–n*.
employed, also, to restrain uterine hemorrhage, for expulsion of placenta, polypi, hydatids, and in puerperal convulsions, *ibid.*
its want of astringency, and in sometimes arresting other hemorrhages than uterine, illustrates, like Cold, Ipecacuanha, and Counter-Irritants, the modus operandi of Astringents through reflex action of the nervous system, p. 627–628, § 892⅔ *o*. Also, Astringents, Cold, &c., *Index II.*
fatal to some small animals—illustrating distinctions in vital constitutions, p. 622, § 893⅔ *c*. Also, p. 61–63, § 133–137; p. 88, § 185; p. 98, § 191 *a*.

Erysipelas—complex pathology of, and treatment of, § 630 *e*, 689 *l*, 814, 970 *c*, 1005 *j*, 1058 *m*.
employed to show that remedies operate by substituting one pathological condition for another, p. 642–646, § 893 *a–e*; p. 652, § 893 *l*; p. 872, P.S.

Erysipelas—*continued.*
Also, Counter-Irritants, Remedies, Therapeutics, *Index II;* § 905 *b.*

Exciting Causes. See Causes, Morbific, *Index II.*

Excito-Secretory Action, as resulting from Reflex Action of the Nervous System. See Secretion and Excretion, Generalization of Reflex Action of Nervous System, *Index II.*

Excretion. See Secretion and Excretion, *Index II.*

Exercise,
its modus operandi consists especially in instituting through muscular action a salutary reflex nervous influence upon various organs, but particularly upon the stomach, intestines, and liver, while, also, these organs are rendered the source of the same nervous development and its determination upon themselves by the mechanical influences of jolting; hence the superior advantages of running for overcoming habitual constipation, p. 543, § 855; p. 580, § 890½ *d;* p. 670–671, § 902 *m.* Also, Constipation, Habitual; Friction, Respiration, Heat, Cold, Skin, Phthisis, Food, Whooping-Cough, Alteratives, Reflex Action of Nervous System, *Index II.*

Expectorants—continued from *Index I.*,
the name objectionable, as diverting attention from the pathological states, and thus leading to errors in practice, p. 633–634, § 892⅘ *a;* p. 641, § 892⅘ *i;* p. 739, § 984 *c.*

Alteratives adapted to Pulmonic Inflammation substituted for, in Author's Therapeutical Arrangement of the Materia Medica, and Bloodletting ranked as the first in importance, and Tartarized Antimony the second, p. 634, § 892⅘ *b;* p. 641, § 892⅘ *i.*

the substances distributed into four non-stimulating, fifteen stimulating, one stimulating and narcotic, one sedative and narcotic, and three stimulating and antispasmodic, p. 635, § 492¾ *c.*

the several expectorants proper stated, and reasons for their order of arrangement, serving also as an example of the principles upon which the arrangement of other groups is founded, p. 635–641, § 892 *c–i.*

sustain special relations to the pulmonary mucous tissue in its *morbid* states—illustrating the difference in the vital constitution of the same tissue in different organs, and that remedies operate through increased irritability arising from disease, and according to the precise modes in which they

Expectorants—*continued.*
may develop and modify the reflex action of the nervous system, through which their effects are exerted, p. 634–637, § 892⅘ *b-d.* Also, p. 62–64, § 136–140; p. 65, 66, § 143; p. 67, § 149–151; p. 73, § 163; and Remedies, Remedial Action, Reflex Action of Nervous System, Secretion and Excretion, *Index II.*; Nervous Power, *Index I. and II.*

all of them capable of useful or injurious effects, but two only ever wanted in acute pulmonic inflammation, the others in chronic conditions alone, p. 634–635, § 892⅘ *b, c.*

why Squill is ranked before two of the non-stimulating, p. 635–636, § 892⅘ *c.*

the best effects, especially of the non-stimulating, may or may not result in expectoration, which shows the alterative principle upon which remedies operate, p. 637, § 892 *d, e.* Also, Alteratives, *Index II.*

the utility of bloodletting and tartarized antimony in acute pulmonic inflammation, p. 641–642, § 892⅘ *i.* Also, Pneumonia, *Index II.*

resolution, not expectoration, is wanted, if possible, in all cases of active pulmonic inflammation, and as cough depends upon a variety of pathological conditions, it is a very slender guide to the treatment, which should be determined by all the symptoms as significant of their exact cause or causes, and it may be then found that something else than Expectorants are the appropriate remedies, p 636–642, § 892⅘ *d–i.* Also, p. 428, § 674 *a;* p. 437–442, § 684–686; p. 456–460, § 695–708; p. 479–480, § 741 *a, b;* p. 541–542, § 854 *bb;* p. 548–550, § 863 *d;* p. 551–554, § 867–871; p. 572–579, § 680 *d–n;* p. 587, § 891 *k;* p 663–665, § 897–901; p. 738–739, § 984 *c*–985; p. 759, § 1005 *j;* and Whooping-Cough, Phthisis Pulmonalis, *Index II.*

secreted products are a secondary result, symptoms only, however much they may be Nature's means of cure, and may be produced by remedies of opposite virtues through their variously modifying effects upon the reflex action of the nervous system, and may arise as well from an increase as a diminution of disease, whether it occur naturally or be the result of remedies, p. 634, § 892⅘ *a;* p. 637, § 892⅘ *d.* Also, p. 546–551, § 862–864, and Secretion and Excretion, Reflex Action of Nervous System, Remedial Action, *Index II.*; Nervous Power, *Index I. and II.*

ETHER, SULPHURIC. See ANÆSTHETICS, *Index II.*

F.

FEAR,
demonstrates the direct development and profound operation of the nervous influence upon the secretions, contradicts all chemical and physical hypotheses of operation of remedial and morbific agents, and goes to establish the substantive existence and self-acting nature of the Soul; what but the nervous influence will expound the torrent of sweat, the copious flow of urine, the thumping heart, the protruded eyeballs, the ghastly and pallid countenance, while convulsions and purging sometimes enhance the astonishing spectacle—all of which, too, often follow upon loss of blood and the operation of an emetic, and all the phenomena in all the cases equally due to direct or reflex action of the nervous system—and also observe that the sweat, the urine, the intestinal fluids, as supplied by *Fear*, are simple elements of the more profound manifestations of the nervous system in its universal excito-secretory function, while the corresponding results from loss of blood and emetics illustrate the manner in which the nervous system is instrumental in changing the character of the secreted products, according to the manner in which the nervous influence is modified by morbific and remedial agents, p. 230–232, § 422–424; p. 324, § 500 *c*; p. 331, § 500 *o*; p. 332, § 501 *c*; p. 334, § 508–510; p. 341, § 514 *m*; p. 534, § 844; p. 630–631, § 892¾; p. 666–669, § 902 *b–i*; p. 703–705, § 943–944 *b*; p. 708–710, § 951–952; p. 866, § 1067 *a*; p. 877, § 1072 *b*; p. 880, § 1074; p. 891, § 1077. Also, MENTAL EMOTIONS, REMEDIAL ACTION, *subdivision* MENTAL EMOTIONS, REFLEX ACTION OF NERVOUS SYSTEM, SECRETION AND EXCRETION, LOSS OF BLOOD, BLOODLETTING, GENERALIZATION OF REFLEX ACTION OF NERVOUS SYSTEM, COLD, SKIN, KIDNEY, JOY AND ANGER, GRIEF, HOPE, LOVE, JEALOUSY, SHAME, DISGUST, WEEPING, LAUGHING, SEA-SICKNESS, *Index II.*; NERVOUS POWER, *Index I. and II.*

FEVER,
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FEVER—*continued.*
developing a stimulating reflex action of the nervous system which is greatly expended upon the heart and arteries, after the manner of anger, when that passion develops the nervous influence in a direct manner—has none of the morbid products of inflammation, while in the latter the constitutional symptoms yield as soon as the local malady gives way—begin in different modes; no chill in inflammation, unless preceding the formation of an abscess, and no such paroxysms, as to their nature and definite intervals, as in fever, unless in the analogy supplied by phthisis pulmonalis—may subside suddenly, unlike inflammation—pulse and blood differently affected, p. 64–65, § 141–143 *c*; p. 66–67, § 148; p. 429, § 674 *c*, p. 367, § 557 *a*; p. 444–445, § 688 *d–ee*; p. 465–467, § 714–718; p. 489–490, § 755; p. 493, § 764 *e*; p. 495, § 770; p. 496, § 775; p. 497–498, § 779–785; p. 733–736, § 974–980. Also, INFLAMMATION, *Index I. and II.*
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is not contagious, p. 419–420, § 653; p. 537, § 847 *d*, *e*; p. 869, § 1068 *b*, *note*. Also, CONTAGION, *Index II.*
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has three stages, *cold*, *hot*, and *crisis*, or sweating, &c., p. 430–433, § 675; p. 491–493, § 763–764 *c*.
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its formation as a coat upon blood abstracted in inflammations, in pregnancy, &c.—denoting, also, a greater fluidity of the blood than natural, p. 445, § 688 *ee*; p. 710, § 952 *b, c*. Also, PULSE, *Index II.*
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FOMENTATIONS,
their modus operandi in relieving pain and diseases. See POULTICES, HEAT, WARM BATH, *Index II.*

FOOD—continued from *Index I.*,
by simple contact with the stomach, will, like wine, &c., often light up warmth on a cold surface, and invigorate the muscles by the same stimulating influence of reflected action of the nervous system, and, like the physiology of Respiration, and the interchange of action between the skin and kidneys through the same medium, and like the same causation which expounds the various effects of cold air upon internal organs, supplies an elementary principle through which the modus operandi of remedial and morbific agents beyond the direct seat of their operation may be readily understood to depend upon alterative influences of reflex action of the nervous system, and through modifications of that action, according to the nature of the causes, whether physical or mental, by which it is excited, p. 68,

* Also, *Bloodletting* in, NOTES S p. 1124, II p. 1139.

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what is above said of the contact of food with the stomach resolves the paradox of the "*vomited pill of opium*," and of the "*scarlet efflorescence*," as set forth at p. 673, § 904 *b*; though we may bring to the aid of our interpretation what is said of *Idiosyncrasy* at p. 384, § 585 *b*. Also, OPIUM, SUPPOSITORIES, HEAT (*enemas*).
some kinds poisonous to some, but salubrious to most others, owing to the development of a morbific reflex action of the nervous system, p. 384, § 685 *b*. Also, OPIUM (*the pill and "scarlet efflorescence"*), SKIN (eruptions), *Index II.*; NERVOUS POWER, SYMPATHY,
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peculiar functions—*sensation*, p. 280-283, § 450-451—*sympathy* (reflex action of the nervous system), p. 283-362, § 452-530. Also, REFLEX ACTION OF NERVOUS SYSTEM, SYMPATHY, *Index II.*; NERVOUS POWER, *Index I. and II.*
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GALVANISM—ELECTRICITY. See *Index I.*
GASES AND FUMES. See HUMORAL PATHOLOGY, ANÆSTHETICS, *Index II.*; GASES, *Index I.*
GENERALIZATION OF REFLEX ACTION OF THE NERVOUS SYSTEM,
as the medium through which all remedial and morbific agents exert their effects upon parts beyond their direct seat of action, and as universally engaged in the excito-secretory action, not only as a simple excitant, but, what is far more important, as the *modifying* cause of all deviations from their natural standard, with the few exceptions that attend the perfectly local action of escharotics, vesicants, &c., but which modify all the secretions beyond their direct seat of operation through reflex action of the nervous system, including, also, the corresponding effects of the nervous influence as developed by the Passions. See *Medical and Physiological Commentaries*, vol. i., p. 568-574 (1840), and many other places to the same effect; REFLEX ACTION OF THE NERVOUS SYSTEM, REMEDIAL ACTION, REMEDIES; CAUSES, MORBIFIC; THERAPEUTICS, SECRETION AND EXCRETION, MENTAL EMOTIONS, REMEDIAL ACTION, *subdivision* MENTAL EMOTIONS; SYMPATHY, *subdivision* REMOTE AND CONTIGUOUS, *Index II.*; NERVOUS POWER, *Index I. and II.*

Generalization, &c.—*continued.*
of which the following are some of the illustrations of the foregoing imputed effects of direct and reflex action of the nervous system: *Cathartics, Emetics, Bloodletting, Loss of Blood, Leeching, Antispasmodics, Counter-Irritants, Seton, Alteratives, Narcotics, Sedatives, Expectorants, Diuretics, Astringents, Tonics and Stimulants, Mercurial Remedies, Anæsthetics, Elaterium; Antimony, Tartarized; Tobacco; Oil, Croton; Hydrocyanic Acid, Plasters; Hydrophobia, Virus of; Predisposition to Diseases; Self-limited Diseases, Convulsions, Phthisis, Asthma, Inflammation; Brain, Inflammation of; Amenorrhœa, Hysteria, Whooping-Cough, Sea-Sickness, Humoral Pathology, Sphincter Muscles, Heart, Skin, Cold, Heat, Warm Bath, Food, Exercise, Friction, Respiration, Defecation, Metastasis; Stomach, Blows upon; Sweat, Urine, Hybernating Animals, Joy and Anger, Hope, Fear, Love, Jealousy, Grief, Shame, Disgust, Laughing, Weeping, Yawning, Roosting, Sneezing, Soul and Instinct,* INDEX II.; *Will,* INDEX I. and II.

GENERATION, SPONTANEOUS, OR SPONTANEITY OF BEING—continued from *Index I.*,
advocated by *Physiologists*, p. 86, § 175 *d*; p. 188–189, § 350 *l, m.*
facts and arguments against, p. 910–911, § 1083. Also, GENERATION, *Index I.*
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GENITO-URINARY AGENTS,
introduced to illustrate the principles on which the Author's *Therapeutical Arrangement of the Materia Medica* is based, p. 684, § 905½ *a, b*; p. 687–889, § 905½ *c.* Also, p. 634–636, § 892⅘ *b, c.*
present a large variety of remedial virtues, which are mostly relative to the genito-urinary organs, and thus illustrate what is meant by specific action, being addressed directly to these organs, and not regarding their diseases as sympathetic of derangements of other parts, however much they may be so, p. 687–689, § 905½ *c.* Also, p. 62–64, § 135–138; p. 65, § 143 *a*; p. 66, § 143 *d*; p. 545, § 859 *b*; p. 584–585, § 891 *d*; p. 592, § 891½ *i*; p. 623, § 892¾ *c*; p. 634, § 892⅘ *b.*

GEOLOGY, THEORETICAL,
the Author's work upon, p. 908, § 1079 *b.*

GONORRHŒA,
its principles of treatment, p. 576, § 890 *m*; p. 689, § 905½ *c.*

GRIEF,
demonstrates Author's theory of the operation of remedial and morbific causes through the medium of direct and reflex action of the nervous system, contradicts the chemical and physical hypotheses, and goes to confirm Author's demonstration of the substantive existence and self-acting nature of the Soul, p. 326–327, § 500 *f, i, j*; p. 331, § 500 *o*; p. 341, § 514 *m*; p. 534, § 844; p. 630–631, § 892¾; p. 703–705, § 943 *a*, 944 *b*; p. 709, § 951 *c*; p. 866, § 1067; p. 877, § 1072 *b*; p. 880, § 1074. Also, MENTAL EMOTIONS, REMEDIAL ACTION, *subdivision* MENTAL EMOTIONS, SECRETION AND EXCRETION, FOOD, JOY AND ANGER, LOVE, FEAR, JEALOUSY, HOPE, SHAME, DISGUST, LAUGHING, WEEPING, YAWNING, ROOSTING, SNEEZING, SOUL AND INSTINCT, *Index II.*; WILL, *Index I. and II.*

GRANULATION,
evinces great Design, and involves profound physiological laws, p. 472–475, § 733 *c–f.* Also, INFLAMMATION, *Index II.*

H.

HALL, MARSHALL, and the Author.
his opinion of the cause of voluntary motion, p. 77, § 167 *f.* Also, WILL, MENTAL EMOTIONS, *Index II.*; NERVOUS POWER, *Index I. and II.*
experiments on nervous system adversely to A. P. W. Philips, p. 306–310, § 483 *b*–484—proving to have been a repetition of ALSTON'S, p. 309, No. 4.
advocates the chemical and humoral hypotheses of operation of remedies and secretion, but is contradicted by his own experiments, p. 308, § 483 *c*; p. 342, § 514½ *b.* See, also, *Medical and Physiological Commentaries*, vol. iii., Essay on Modus Operandi of Remedies (1842), in which occurs the example of the SETON, as presented at p. 679–681, § 905 *a* of these INSTITUTES; and vol. i., p. 569–574 (1840), where appears a distinct and anatomical exposition of the reflex action of the nervous system as applied by the Author to Pathology and Therapeutics, and where he presents it in array against the *humoral pathology*, and as being all that is ever concerned in the modus operandi of remedies and of morbific causes (and in the example of the *Seton* also) beyond their direct seat of action—the Author being in advance of the one, and, unfortunately, not sufficiently submissive for the rest, to the chemical and humoral doc-

Hall, Marshall—*continued.*
trines of the day. It may be added, also, that in either of the above references to the *Commentaries* will be found, quite elaborately set forth, "THE GIST OF THE WHOLE MATTER," *Institutes*, p. 814.
affirms that the sympathies in organic life are owing to the mutual influences of organs among each other, p. 308, § 483 *c*.
believes that the "spinal marrow, *exclusive of the cerebrum*, is the SOURCE of animal life"—and that "the *irritability* of the muscles of organic life *depends* probably on the *ganglionic system*," p. 296, § 476½ *b*. Also, p. 88, § 183, 184 *a*; p. 89, § 188 *a*; p 100–102, § 194–202; p. 284–290, § 455–461½. Also, objections to, in Essay on MODUS OPERANDI OF REMEDIES in *Medical and Physiological Commentaries*, vol. iii (1842).
supposes "all convulsive affections to be *diseases* of the true spinal or excito-motory system," and Author's objections, p. 357, § 526 *d*; p. 467–468, § 719. Also, CONVULSIONS, HYSTERIA, WHOOPING-COUGH, *Index II.*
his contributions toward the laws of reflex action of nervous system, p. 290, § 463 *b*.
supposes organic actions to depend upon the nervous system, and not upon properties inherent in all parts, p. 217, § 399. Also, VITAL PROPERTIES, ORGANIC LIFE, *Index I.*
his experiments showing the circulation of the blood *independently* of the sympathetic system, p. 127, § 263.
his opinion upon bloodletting as to rule of practice, and Author's objections, p. 712–713, § 955 *d*; p. 715, § 959 *a*. Also, extended objections to, in *Medical and Physiological Commentaries*, vol. i., p. 216–233, p 239–271 (1840)
his opinion as to tolerance of loss of blood, and Author's objections, p. 728–729, § 965. Also, critical objections to, in *Medical and Physiological Commentaries*, vol. i., p. 239–271 (1840).
his opinion as to "excessive reaction from loss of blood," and Author's objections, p. 469, § 722 *d*; p. 772–776, § 1020–1026. Also, critical objections to, in *Medical and Physiological Commentaries*, vol. i., p 239–271.

HABIT, VITAL,
so designated and investigated by the Author through a long chain of analogies, embracing the results attendant upon natural, morbific, and remedial agents, and of the mind, p. 363–370.
relates to the modifications of functions, and the variations of their results as

Habit, Vital—*continued.*
arising from the repeated or continued operation of causes, and lies at the foundation of some of the most important and comprehensive laws in Medicine, p. 363, § 535; p. 364–369, § 542–563; p. 532–533, § 841; p. 567–569, § 889 *l–mm*; p. 585, § 891 *f*; p. 648–649, § 893 *g*, *h*; p. 675–676, § 904 *b*.
belongs to both plants and animals, p. 363, § 536–538.
philosophy of, in organic and animal life, p. 363–370, § 539–568
illustrated by effects of natural, remedial, and morbific agents, p. 257–258, § 442 *b*, *c*; p. 364–369, § 542–563; p. 425, § 664, p. 532–533, § 841; p. 567–569, § 889 *l–mm*, p 585, § 891 *f*; p. 648–649, § 893 *g*, *h*; p 675–676, § 904 *b*; p 809, § 1047. Also, ACCLIMATION, *Index II.*
manifested by the Mind and Instinctive Principle, p 369–370, § 564–568; p. 894–895, § 1078 *b*.
illustrates the instability of the vital properties, p. 363, § 541. Also, VITAL PROPERTIES, *Index I.*
generally results in diminished irritability, but may be the reverse, and either practically important, with illustrations, p. 366–367, § 556 *a–d*; p. 532–533, § 841; p. 567–569, § 889 *l–mm*; p. 585, § 891 *f*.
always relative to impressions, more or less durable, upon the vital, mental, or instinctive constitution, p. 363, § 540; p. 894–895, § 1078 *b*.
liable to obtain under the repeated or continued operation of almost all agents capable of affecting the vital or mental properties, p. 364, § 543.
through which miasmata, tobacco, crude food, &c., cease to be injurious, p. 364, § 544. Also, ACCLIMATION, *Index II.*
or may obtain from one application of particular causes, so as to render them inoperative afterward, p. 364, § 545.
lessens or increases the susceptibility of organs to the action of remedies, p. 364, § 546; p. 532–533, § 841, p. 542, § 854 *c*, *d*; p. 665, § 901.
demonstrates the operation of remedies and morbific causes by alterative influence of reflex action of the nervous system, p. 364, § 547; p. 532–533, § 841; p. 649, § 893 *h*.
its effects generally most prominent in organic life when causes are long in operation—a law of great practical bearing, p. 364, § 548 *a*, *b*
not much applicable to food and other perfectly natural stimuli—showing Design; though some kinds liable to, p. 364–365, § 548½ *a*, *b*.

Habit, Vital—*continued.*
follows, in respect to morbific and remedial agents, the law which governs the relative duration of disease when produced by remedies and truly morbific causes, p. 365, § 549–554; p. 366, § 555; p. 542, § 854 *c–d*, p. 665, § 901. Also, Cantharides, Counter-Irritants. *Index II*
illustrated by the tolerance of frequently-repeated and increased doses of medicines, and its subsidence on their suspension for a short time, p. 364, § 543; p. 365, § 551, 552, p. 532–533, § 841; p 569, § 889 *mm*; p. 649, § 893 *h*.
its effects vary according to the exact nature of its causes, p. 366, § 553.
allied to the principle which lies at the foundation of disease and its cure, p 366, § 555, p 542, § 854 *c–f*
liable to be influenced by accidental causes, and to thus affect the treatment of disease, with examples, p 367, § 556 *d*–557.
embraces the *cumulative* effect of remedies, and *predisposition* to disease, with illustrations, p. 368, § 558 *a*, *b*, 559; p. 568–569, § 889 *m*, p 669–670, § 902 *i*; p. 675–676, § 904 *b* Also, Predisposition, Remedies, *Index II.*
relates to the tenacity of many diseases, p 368, § 560—and to many acquired natural habits of the constitution, § 561—and to luxuries and customs, § 539 *a*, 543, 548½ *b*, 562—and to the periodical desire of food, and many little usages, § 563—and to the culture of the mind, or of any mental faculty at the expense of others, and to its enjoyments, and to the senses, and to the voluntary muscles, § 543, 564–567—and to analogies between certain special injuries in organic life and of the mind, p 370, § 568; p. 894, § 1078 *b*

Heart. See Heart and Arteries, *Index I.*,
constantly influenced, and the arteries also, in all diseases, by reflex action of the nervous system, and the pulse is felt simply for the purpose of ascertaining the extent and nature of these influences, and of thus arriving at the nature and extent of the remote affection, while, also, the heart and arteries do not often fall under the *alterative* influence of the reflex action so far as to produce disease—employed by the Author, along with many other analogous things, to illustrate the reflex action of the nervous system as the immediate cause of diseases and their cure through its alterative influences upon the organic states, beyond the

Heart—*continued.*
direct seat of operation of remedial and morbific causes—the nervous influence being rendered variously alterative, or simply stimulating or sedative, according to the nature of the causes by which it is brought into any increased or preternatural operation, p. 301–310, § 480–485; p. 355–356, § 526 *a*, *b*; p 443–448, § 687½–688; § 714, 715, 961 *a*.
its highly irritable nature employed by the Author to *prove* that remedies do not operate by absorption, since the most powerful, when swallowed, act mostly upon other parts, and do not often affect the heart, except by reducing diseases upon whose morbific reflex nervous influences the disturbances of the heart depend, § 500 *m*, 687½, 694¾, 826 *cc*, 829, 893 *c*, *p*, 904 *c*–905 *a*, 973–995, 1024.

Heat—continued from *Index I.*,
applied to the surface, or intestinal canal, by stomach or rectum, and, whether dry or moist, illustrates, like Cold, the operation of remedies and morbific causes through alterative influence of reflex action of the nervous system, and supplies, in its varieties, whether dry or moist, and the different temperatures, from 98° to 120° Fah., a critical illustration of the modifications which the reflex influence undergoes, and through the manner in which it impresses organs favorably or unfavorably, according to their existing susceptibilities, and according to the degree or kind of heat; illustrates, also, the modus operandi of remedial and morbific agents through the same alterative reflex nervous influence, and equally according to the nature and intensity of the agents, and that, although closely allied, our remedies may be curative or morbific according to their exact nature and dose, p. 246, § 440 *e*; p 253, § 441 *d*; p. 351, § 524 *a*; p. 589, § 891 *p*; p. 681–683, § 905 *a*. Also, Warm Bath, Cold, Skin, Friction, Food, Exercise, Respiration, Cathartics, Emetics, *Index II.*
operates in raising the temperature of the surface as a stimulus of organic actions, and without the agency of the nervous system, but will not so influence the reflex action of the nervous system as to raise the temperature of internal organs, nor will cold reduce it unless it impair their functions—a remarkable evidence of Design when contrasted with the manner in which Croton oil, and leeching the anus, will develop a powerful re-

Heat—*continued.*
flex nervous influence through the mere propagation of *continuous* sympathy along the mucous tract of the intestine, p. 249–250, § 441 *c*; p. 256–259, § 441½–442 *e*; p. 809–812, § 1046–1050. Also, Organic Heat, *Index I. and II.*; Hybernating Animals; Oil, Croton; Leeching, Suppositories, Sympathy, subdivision *continuous*, *Index II.*
simple warm water, as an enema, among a multitude of analogies in these *Institutes*, by its development of a stimulating reflex action, and its determination of an exciting effect upon the muscular coat of the intestine and abdominal muscles, shows that if Croton Oil, or other cathartic, be added to the water, the alterative effects of the latter upon remote diseases is through the same reflex influence, now modified by the nature of the added cathartic, and carried by the Author to the interpretation of all remedial and morbific agents beyond their direct seat of operation through alterative influences of reflex action of nervous system, *ibid.*, and Suppositories, Opium (*the pill*, &c.), Reflex Action of Nervous System, Remedial Action, *Index II.*; Nervous Power, Sympathy, *Index I. and II.*

Heat, Animal. See Organic Heat, *Index I. and II.*

Hemorrhage, Spontaneous,
philosophy of, practically very important—not owing to ruptured vessels, but morbid vascular action, p. 507, § 805; p. 509, § 812; p. 533, § 842; p. 572, § 890 *a–h*; p. 694, § 922; p. 738–739, § 984 *c*–985; p. 770–772, § 1018–1019. Also, Medical and Physiological Commentaries, Article *Pathology of Cerebral Hemorrhage*, vol. i., p. 371–384; Article *Spontaneous Hemorrhage*, vol. ii., p. 546–550.
if what the Author has said of the physiology of Bloodletting and Leeching be founded in nature, it is obvious that the foregoing comparative safety of spontaneous hemorrhage must depend upon a comparatively milder development of the nervous influence when Nature institutes the loss of blood, p. 694, § 922 *b*—and the interpretation is farther confirmed by the comparatively slight prostration that results from the drain in malignant cholera, prolonged diarrhœa, abscesses, mennorrhagia, &c., with such as is brought about by the continued use of the mildest purgatives.
nature's mode of cure, and often successfully in such quantities as cannot

Hemorrhage, Spontaneous—*continued.*
be imitated by art, and in such advanced stages of disease that bloodletting is inadmissible, p. 471–472, § 732; p. 507, § 805; p. 550, § 863 *f*; p. 573–575, § 890 *e–f*, p. 770–772, § 1019; Notes Ff p. 1135, II p. 1139.
Nature, therefore, concurs with experience in protesting against the use of Astringents to restrain this natural means of cure, unless proceeding to an alarming excess, p. 573–575, § 890 *a–h*; p. 771–772, § 1019 *g*, *h*. Also, "Debility," *Index I. and II.*
nevertheless, when practicable, as in the early stages of disease, and if the hemorrhage proceed from an important organ, the pathological condition should not be left to Nature, but Art should interfere with its direct Antiphlogistics, especially Bloodletting, Tartarized Antimony, and Vesicants, and this particularly in pulmonary hemorrhage. See foregoing *references*, and Expectorants, Astringents, Pneumonia, *Index II.*
all preternatural effusions are designed for useful ends, and form some of the most remarkable examples of Design. If they take place within cavities or the structure of organs, it is still the same, nor does Nature depart from any great law for the sake of special exigencies, p. 471–476, § 732 *b*–733; p. 546–547, § 862–863 *d*; p. 550–551, § 863 *e*–864.

Hiccough,
introduced to illustrate the coincidences which attend the operation of the nervous influence, whether brought into action by the mind or by physical causes—presenting an example of a paroxysm brought on by a sense of choking, which was evidently the result of reflex nervous action induced by gastric derangement, and which had the effect of exciting through mental sympathy the same condition in three others that antispasmodics failed of removing, but which was overcome in all the cases by a mustard emetic—thus illustrating, as in hysteria, the modus operandi of an emetic in arresting the paroxysms through the development of another series of reflex actions and the introduction of movements in other associated muscles, though most successfully in the mental cases whose causes were more transient—and illustrating the difference in the modes in which antispasmodics and emetics relieve spasmodic affections through the agency of reflex action of the nervous system, and the differences among other things to the

Hiccough—*continued.*
same effect (as may be seen in the references below)—and illustrative of the delicate shades in variety in which mental emotions modify the nervous influence, and how, through their medium, the mere *disgust* arising from the thought of taking an emetic will develop the nervous influence so as to stop a paroxysm of hysteria without vomiting, and contrasted with the effect of an emetic in overcoming the same, and with the united effect of *disgust* in other cases as brought on by the recollection of a former occurrence of the same nature—while the whole, in all its wonderful relations to the mind in its endless variety of demonstrations upon the organic mechanism through its direct development and diversified modifications of the nervous influence, and the perfect correspondence in these respects with the effects of physical agents applied to the nervous centres, or as they may be affected by disease, and thus develop the nervous influence in a direct manner, or as other physical causes give rise to reflex action, and, in all the cases, modify the nervous influence in a manner analogous to the various mental emotions, not only reflect a flood of light upon the modus operandi of all morbific and remedial agents, but, through the foregoing analogies between the mental and physical causes, declare the substantive existence and self-acting nature of the *Soul*, p. 337–338, § 514 *c*. Also, Hysteria and Hiccough, Convulsions, Whooping-Cough, Antispasmodics, Emetics, Disgust, Fear, Mental Emotions, Soul and Instinct, Remedial Action, Reflex Action, *Index II.*; Nervous Power, Sympathy, *Index I. and II.*

Hope,
"cheer up the patient, and he is sure to do well," or, as Hippocrates has it, "he doeth the best cures in whom most trust"—who can mistake an antagonistic substantive cause—something more than imaginary—acting in opposition to itself, when grief, disappointment, despondency, despair, lay deeply the foundations of disease, but rarely too deeply for the mastery of Hope—who can mistake a common substantive, self-acting agent, known as the Soul, which develops and *modifies*, according to the nature of each emotion, another agent known as the nervous power, or nervous influence (no matter which), upon whose alterative effects, and as it may be rendered

Hope—*continued.*
morbific or curative by the Spiritual part, all the astonishing variety depends; and who so unjust to his reason as not to concede an exact analogy between the modus operandi of these and other emotions, and of all physical causes, whether morbific or remedial, and thus embrace the operation of the whole under a common philosophy—or, reasoning from the latter to the former, equally concede the instrumentality of the nervous influence in the former case, and its development by an agent of the same substantive existence as the physical causes, p. 107–111, § 227–233¾; p. 324, § 500 *c*; p. 326, § 500 *g*; p. 327, § 500 *j*; p. 333, § 503; p. 534, § 844; p. 661–664, § 894 *b*–900; p. 667, § 904 *c*; p. 865–868, § 1067; p. 879–882, § 1074–1075; p. 886–891, § 1077. Also, Mental Emotions, Grief, Joy and Anger, Love, Jealousy, Weeping, Shame, Disgust, Fear, Food, Hunger, Thirst, Respiration, Exercise, Skin, Cold, Heat, Convulsions, Antispasmodics, Seton; Causes, Morbific; Remedies, Cathartics, Emetics, Remedial Action, Soul and Instinct, *Index II.*

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I.

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the constitutional excitement of local inflammation is owing to remote sympathy, while that of fever arises from the disease at large throughout the system—the exciting influence of the reflex action of the nervous system, in the former case, being determined especially upon the heart and arteries, while, also, the same phenomenon is most strongly pronounced in inflammation of the brain, when the development of the nervous influence is *direct*, as in the case of the Passions, but instituting, as a consequence, circles of reflex action, p. 227, § 411; p. 355, § 526 *b*; p. 465–468, § 714–719; p. 804–805, § 1040, and *references* there. Also, Brain, Inflammation of; Joy and Anger, and the other individual *Passions*, Fever, first *subdivision*, *Index II.*
no "general" inflammation, and the term "inflammatory fever" hypothetical and objectionable, p. 466, § 716.
farther, the foregoing exciting and alterative influence of reflex action of the nervous system upon the general circulatory system, and its local determination upon individual parts, is the cause of consecutive inflammations, while each one as it comes forward in the progressive series joins in the development of the morbific reflex action, and thus also mutually aggravate each other, and multiply the ratio of the consecutive derangements—and these disturbances of the never-ceasing, ever-changing reflex action will depend greatly upon the activity of disease, and upon the importance of the organs and the nature of the tissue affected, though not always so, p. 227, § 411; p. 355, § 526 *o*; p. 465–466, § 715; p. 467–468, § 718, 719; p. 506–509, § 806–811; p. 511, § 815; p. 679–681, § 904 *a*; p. 724–727, § 961; p. 730, § 969; p. 731, § 970 *c*; p. 732–734, § 973–975; p. 804–805, § 1040, and *references* there. Also, Structure, Reflex Action; Causes, Morbific, *Index II.*; Nervous Power, Sympathy, *Index I. and II.*
such is the correspondence among the foregoing influences and derangements, that a modification may be given to the reflected nervous influence by a single remedy, as Bloodletting and Tartarized Antimony (and in fever also, and as complicated with inflammation), that will overthrow all the extensive lesions, p. 65–66, § 143 *c*, and *references* there; p. 66–67, § 148; p. 465–466, § 715, and *references* there; p. 498, § 784 *b*, and *references* there; p. 731–732, § 970 *c*.
produces, also, through the foregoing sympathetic influences, other forms of disease, which concur in modifying the reflex nervous influence, and this often depending upon the special vital constitution of tissues and organs, p. 467, § 718. Also, Structure.
the development and modification of the reflex action of the nervous system, and its influence upon one part or another, depends, more or less, not only upon the special vital constitution of tissues and the relations which they bear to compound organs as one or another may be the seat of inflammation, and more or less so as it respects

Inflammation—*continued.*
the determination of the morbific influence upon different parts, but its influence when resulting from venous inflammation is a strong exemplification of the special modes in which the alterative influence of reflex nervous action is modified by the nature of a tissue when affected by a common form of disease, and serves to illustrate the great fact that every cause, both physical and mental, that may bring it into operation, imparts to it a special modification peculiar to its own virtues, p. 444–446, § 688 *c, f*; p. 506–509, § 806–811; p. 511, § 815; p. 724–726, § 961; p. 730, § 969; p. 731, § 970 *c*; p. 732–734, § 973–975. Also, Structure, *Index II.*; Nervous Power, *Index I. and II.*; Venous Congestion, Venous Tissue, *Index I.*
develops a reflex action of the nervous system which imparts to the pulse its peculiar characteristics of *hardness* and *incompressibility*, and the peculiar modification of the nervous influence as instituted by inflammation is farther manifested in its production of those changes of vascular action that lead to the buffing and cupping of abstracted blood, while, on the other hand, this protean power may be almost instantly made to change its shape and establish a totally new order of things under the loss of blood or a mental emotion, p. 227, § 411; p. 355, § 526 *a*; p. 444–445, § 688 *a–f*; p. 708–710, § 951–952 *b*; p. 804–805, § 1040, and *references* there.
develops an exciting nervous influence which sustains the system under the loss of blood, though of some tissues, and in their connexion with compound organs, more than others, while the loss of blood so modifies the alterative influence of the reflex nervous action (and upon which all the phenomena of Bloodletting depend) as to speedily change the whole condition, p. 732–736, § 973–980. Also, p. 70–73, the Tables; p. 227, § 411; p. 355, § 526 *a*; p. 444–446, § 688 *d*; p. 506–509, § 806–811; p. 511, § 815; p. 709–710, § 952; p. 724–734, § 961–976; p. 735–736, § 978–980; p. 804–805, § 1040, and *references* there. Also, Bloodletting, Loss of Blood, Reflex Action, Antispasmodics; Brain, Inflammation of; Structure, *Index II.*; Nervous Power, Sympathy, *Index I. and II.*; Venous Congestion, Venous Tissue, *Index I.*
when affecting the brain, the exciting nervous influence is greater than of other organs, and here, too, the nervous influence is developed in a *direct* manner, and the motor nerves are alone concerned; but as soon as felt by other organs, they react upon the nervous centres, and give rise to circles of reflex action, p. 671, § 903; p. 733–734, § 974 *c*–975. Also, Venous Congestion; Brain, Inflammation of; Mental Emotions, the individual *Passions*, *Index II.*
when affecting any important organ in small-pox, measles, and scarlet fever, it gives rise to such alterative influences of the reflected nervous action as enables the system to bear the remedies that would be necessary when the same disease occurs independently, and which might be otherwise fatal, p. 59, § 129 *h, i*; p. 61, § 134; p. 63, § 137 *b–e*; p. 65, § 143 *c*; p. 67, § 150–151; p. 69, § 156 *b*; p. 73, § 163; p 227, § 411; p. 355, § 526 *a*; p. 538–539, § 847 *g*–849; p. 542–543, § 854 *f*; p. 544–545, § 858; p. 804–805, § 1040, and *references* there.
all the foregoing influences of reflex action of the nervous system are examples of that alterative action as brought into operation by all remedial and morbific causes, physical and mental, whenever they act upon parts beyond the seat of their direct operation, though variously modified according to the nature of the exciting cause, and are the medium through which all the remote changes in the solids and the fluids (the blood included) are brought about, p. 483–484, § 746 *c*; p. 679–681, § 905 *a*. Also, Bloodletting, Loss of Blood, Cathartics, Emetics, &c.; Causes, Morbific; Remedies, Therapeutics, Remedial Action, Secretion and Excretion, Reflex Action of Nervous System, Mental Emotions, the individual *Passions*, &c., *Index II.*
founded wholly upon the physiological states, § 749–751. Patholog. Cause.
Inflammation, Pathological or Proximate Cause of,
supplies the whole philosophy of other diseases, p. 482, § 745.
its immediate instruments the extreme arterial capillaries, the nerves and absorbents participating, p. 483, § 746. Also, p. 220–227, § 409 *b*–411; p. 355, § 526 *a*.
irritability and mobility increased, p. 484, § 747. Also, p. 89, § 188; p. 103–104, § 205–215; Organic Life, Vital Properties, Vital Principle, *Index I.*

Inflammation, &c.—*continued.*
constituted by an active contraction and dilatation of arteries and veins, but more especially by a change in the natural kind, and an increased circulation and volume of blood, p. 209–210, § 384–387; p. 214–215, § 392–396; p. 216, § 399; p. 305–310, § 483–485; p. 485–486, § 750–751; p. 503, § 794; p. 792–793, § 1032 *d*; p 803–804, § 1039, 910, 935 *c*, *d*.
mechanical theory of, which supposes passive relaxation of vessels, and stagnation and coagulation of blood, but which is contradicted by facts, p. 484–486, § 748–751. Also, *Medical and Physiological Commentaries*, vol. ii., p. 141–214.
Hunter's opinion of, p. 484, § 747.
Magendie's opinion of, p. 482, § 744.
active and "*passive*" shown to be essentially the same, p. 486–489, § 752–756.

Inflammation, Treatment of,
discussed under the several practical subjects, Bloodletting, Cathartics, Tonics and Stimulants, individual *Remedies*, &c., *Index I. and II.*
Table, indicative of the variety in the vital constitution of different tissues and compound organs, and of parts of a continuous tissue, illustrated by their relative liability to inflammation, and by the effects of some remedial agent, as bloodletting, upon the various tissues of organs, p. 70–73, § 160–162—and another of the relative liability of different tissues of the same nature remote from each other to sympathize together in their diseases, respectively, through reflex action of the nervous system, p. 353, § 525 *a*—and another showing the relative liability of different tissues, respectively, when morbidly affected, in any one part, to continuous sympathy in their several parts, p. 354, § 526 *a*, and in connexion with Tables at p. 70–73—all serving as an important basis of an extended philosophy in Physiology, Pathology, and Therapeutics. Also, Structure; Sympathy, Continuous, *Index II.*; Nervous Power, Sympathy, *Index I. and II.*

Instinct. See Soul and Instinctive Principle, *Index II.*; and Instinct, *Index I.*

Intestine,
contrary to opinions before entertained, this organ is subjected very greatly to the control of the *Will*; and that it is closely allied to the respiratory and sphincter muscles in being also under the influence of reflex action of the nervous system, and liable to a

Intestine—*continued.*
temporary suspension of that influence by an act of volition; and that the whole intestine is subject to this compound influence, though perhaps the lower more than the upper part, is evident from what is said in the text, and as will be more apparent from considering how completely a strong desire for defecation may be resisted till the increased reflex nervous action is fully overcome by counteracting nervous influence determined by the *Will* upon the intestinal muscular tissue—being a very remarkable instance of the action of the *Will* in Organic Life, and forming, in connexion with its associate action upon other muscles concerned in defecation, an impressive example of Design, p. 325, § 500 *e*; p. 326, § 500 *h*; p. 867, § 1067 *a*—while, also, it appears that the stomach is partially liable to influences of the *Will*, as seen in spontaneous vomiting, p. 327, § 500 *j*—and in its control over sea-sickness, p. 889–890, § 1077. Also, Mental Emotions, Reflex Action of Nervous System, Antispasmodics, Sea-Sickness, Fear, *Index II.*; Will, Nervous Power, *Index I. and II.* Also, p. 349. § 519.
different portions of, according to the special vital constitution of each part, when affected by disease, or when certain cathartics operate, develop differently, and occasion different reflex influences of the nervous system, and require modifications of treatment as the same disease may affect one part or another, and reasons assigned for the rapid development of a curative or morbific reflex action of the nervous system when cathartics operate, p. 467, § 718; p. 565, § 899; p. 856–857, § 1063 *b*. Also, p. 62–67, § 135–151; p. 70, Table II.

Iodine,
its introduction into practice, p. 614, § 892½ *d*.
exemplifies, like arsenic, tartarized antimony, &c., the fallacy of reasoning from the effects of remedies upon the healthy system to its morbid states, since it produces its effects only upon very special conditions of the latter, and thereby, as with the effects of all other remedies, demonstrates the mutability of the properties of life, and their greater susceptibility when morbidly affected, and goes with the rest in supplying interesting problems for *chemical* interpretation, p. 612, § 892½. Also, p. 3, § 2 *b*; p. 120–122, § 237–240; p. 352, § 524 *d*; p. 435, § 680; Arsenic; Antimony, Tartarized;

Iodine—*continued.*
Remedies, Therapeutics, *Index II.*; Vital Properties, *Index I.*
some of its imputed evil effects rarely if ever witnessed, p. 612, § 892½ *a*.
often as efficient when applied externally as internally, while, in the former case, it must be in the region of the affected organ—thus showing, as in the case of counter-irritants, &c., that its operation, when employed internally, is not by absorption, but in both cases alike by alterative influence of reflex action of the nervous system, p. 613, § 892½ *c*; p. 619, § 892½ *t*. Also, Counter-Irritants, Sedatives (*Aconite*), Alteratives, *Index II.*; Nervous Power, Sympathy, *Index I. and II.*; p. 930–931, § 1088 *b, c*.
adapted only to bronchocele, and not to other affections of the thyroid gland, p. 613, § 892½ *c*.
its uses in scrofula, &c., depend much upon other appropriate treatment, p. 615, § 892½ *e*; p. 619, § 892½ *s, u*.
examples of its curative effects in obstinate chronic indurations of liver, spleen, uterus, lymphatic glands, &c., p. 615–616, § 892½ *f*. Also, Leeching, *Index II.*
is stimulating, and, if inflammation be active, and especially of any important organ, it should be reduced by general bloodletting before employing iodine, and leeching is often useful in indolent conditions, p. 615, § 892½ *c*; p. 619–620, § 892½ *u*—and a neglect of which in early phthisis cuts off the chance of recovery, § 892½ *e*.
its uses in skin diseases, secondary syphilis, &c., p. 617, § 822½ *g–i*.
in amenorrhœa of scrofulous subjects, and how it relieves, p. 685–686, § 905½ *b*. Also, Amenorrhœa, *Index II.*
in chronic rheumatism and gout, ill-conditioned ulcers, &c., p. 617–618, § 892½ *l–p*.
useful in dropsies complicated with organic disease, by relieving the latter, but not in other cases, p. 617, § 892½ *k*; p. 630, § 892¾ *a*.
fucus vesiculosus, burnt sponge, cod-liver oil, how did they get into practice? p. 619, § 892½ *r*.
Ipecacuanha,
its virtues illustrated through its salutary effects in its largest and smallest doses upon various conditions of disease—illustrates, along with Cold, Opium, &c., the modus operandi of Tonics and Astringents through alterative influence of reflex action of nervous system—and employed to show the importance of addressing remedies not only to the exact pathological
Ipecacuanha—*continued.*
conditions, but to those particularly which may have established and maintain sympathetic derangements, p. 533, § 842; p. 554–555, § 872 *a*; p. 557, § 873 *a*; p. 572, § 890 *bb*; p. 573, § 890 *d*; p. 576–578, § 890 *l–o*; p. 634, § 892⅘ *g*; p. 641, § 892⅘ *i*; p. 851, § 1059. Also, Alteratives, Astringents, Cold, Opium, Ergot, *Index II.*
as an alterative in small doses, p. 557, § 873; p. 851, § 1059. Also, as above, and Antimony, Tartarized; Alteratives, *Index II.*
its action in emetic doses quickened by the union of the sulphate of copper or of zinc, which arises from the sudden increase of gastric irritability effected by the minerals—involving a principle which reaches far into the practical details of other remedies, both in their combinations and consecutive order of application, p. 567–568, § 889 *l*. Also, p. 63, § 137 *d, e*; p. 65–66, § 143 *c, d*; p. 67, § 149–151; p. 73, § 163; p. 367, § 556 *c*; p. 566–569, § 889 *k—m*.
unlike Tartarized Antimony, is accumulative in its small therapeutical doses, and requires a different mode of administration, p. 557, § 873 *a*; p. 567–568, § 889 *l*. Also, p. 365–368, § 549–558; p. 532–533, § 841, and Antimony, Tartarized; Cold, Alteratives, *Index II.* Also, Emetics.
in some constitutions, and whether inhaled in small quantities or taken by the stomach in a grain or less, produces asthmatic breathing through exciting influence of reflex action of nervous system—the coincidences showing how all remedial and morbific agents exert their effects through the same medium, and illustrative of the modus operandi of Anæsthetics, *ut supra*, and Anæsthetics, Antispasmodics, Reflex Action of Nervous System, Sympathy, *Index II.*; Nervous Power, *Index I. and II.*
Iris—continued from *Index I.*,
of extirpated eye, affected by light, p. 806, § 1042.
the physiology of its movements applied by the Author to an interpretation of the modus operandi of remedial and morbific agents through alterative influences of reflex action of the nervous system, p. 340, § 514 *k*—and in illustrating the substantive existence and self-acting nature of the Soul, p. 875–876, § 1072 *a*. Also, *Atropia*, p. 673
Irritability—continued from *Index I.*,
Dr. Carpenter arraigned upon, p. 95–96, § 189 *b*—and upon development

Irritability—*continued.*
of the Ovum, p. 39-40, § 64 *g*—and Digestion, p. 153, § 348—and Absorption, p. 133, § 291—and upon the opinion that the "tendency to *decomposition after death bears a very close relation with the activity of the changes which take place in the part during life*," p. 39, § 64 *g*—and upon "vital properties in the elements of matter" in connexion with "transcendentalism," p. 85–86, § 175 *d*; p. 182, § 350¾ *f*, *note*.

J.

Jalap,
often subdues excited states of the general circulation during its direct action, is the most decisively antiphlogistic of all the cathartics, and the safest of the active purgatives—and its most useful combinations, with some suggestions as to remedial action, p. 547–550, § 863 *d*; p. 686, § 905½ *b*; p. 851–853, § 1060.

Jealousy,
a passion not without its contributions to the Author's philosophy of the modus operandi of remedial and morbific causes, physical and mental, through alterative influence of either direct or reflex action of the nervous system, and going with the rest to illustrate the modifications of the nervous influence according to the nature of its exciting cause, and aiding in Author's demonstration of the substantive existence and self-acting nature of the Soul, p. 95, § 188½ *d*; p. 107–111, § 227–233¾; p. 324, § 500 *c*; p. 326, § 500 *g*; p. 327, § 500 *j*; p. 333, § 503; p. 631, § 892¾ *b*; p. 661–664, § 894 *b*–900; p. 709, § 951 *b–d*; p. 865–866, § 1067; p. 879–882, § 1074–1075; p. 886–891, § 1077; p. 901, § 1078 *l*. Also, Mental Emotions; Brain, Inflammation of; Remedial Action, *subdivision* Mental Emotions, Fear, Love, Hope, Joy and Anger, Shame, Disgust, Laughing, Weeping, Yawning, Sneezing, Respiration, Sphincter Muscles, Exercise, Food, Friction, Skin, Cold, Phthisis, Whooping-Cough, Antispasmodics, Opium, Convulsions, Bloodletting, Reflex Action of Nervous System, *Index II.*; Nervous Power, Sympathy, *Index I. and II.*
illustrates the manner in which, like compounded remedies, a compound Passion will so modify the reflex action of the nervous system as to affect the secretions in a different manner from either of the individual agents, and which furnished a theme for *Sappho*, p. 631, § 892¾ *b*. Also, p. 90–95, § 188½ *d*; Shame, Secretion and Excretion, *Index II.*

Joy and Anger,
the Passions which destroy life suddenly by a sudden and violent determination of the nervous influence upon the brain, and, through that organ, upon the heart, &c., after the manner of blows upon the epigastrium—demonstrate Author's theory of the operation of remedial and morbific agents through alterative influence of reflex action of nervous system—contradict the physical hypotheses—and contribute in establishing demonstration of the substantive existence and self-acting nature of the Soul, p. 95, § 188½; p. 107–111, § 227–233¾; p. 284–286, § 455–457; p. 298, § 476½ *h*; p. 300–302, § 478–480; p. 326–329, § 500 *f–n*; p. 334–335, § 507–511; p. 362, § 634; p. 670, § 902 *l*; p. 704, § 944 *a*; p. 707, § 947; p. 709, § 951 *b–d*; p. 865–868, § 1067; p. 879–881, § 1074; p. 887, § 1077. Also, Stomach, Blows upon, and the several references to *Articles* under Jealousy, *Index II.*
consider, also, their milder operation—how Joy lights up every feature, gladdens the heart, and invigorates digestion; or Anger thumping at your side, but differently from Fear, injecting the face, while Fear blanches it, protruding the fiery eyeballs, though not after the manner of Fear, and imparting herculean strength to the muscles, while Fear paralyzes, and compare with what is said of the development and modification of the nervous influence, both direct and reflex, by physical agents, under Article Generalization of Reflex Action of Nervous System, *Index II.* Also, p. 324, § 500 *c*; p. 326, § 500 *g*; p. 865–868, § 1067; p. 879–882, § 1071–1075.

K.

Kidney,
effect upon, in producing saccharine urine, by pricking medulla oblongata, p. 792, § 1032 *d*.
its diseases, treatment of, p. 450, 451, § 691; p. 847, § 1058 *s*.
the reciprocal sympathies between the skin and kidneys, in their natural condition, through reflex action of the nervous system, evince the great liability of the nervous influence to disturbances from slight causes, and,

Kidney—*continued.*
like the physiology of respiration, supply a key to the whole philosophy of the operation of remedies and morbific causes upon all parts beyond the seat of their direct effects through alterative influence of reflex nervous action—while, also, the torrent of urine which is often generated by the contact of cold air with the surface, and its sudden expulsion from the bladder by the cold dash or by the warm bath, supply a simple element of the universal instrumentality of the reflex nervous influence in inducing disease and of changing the condition of morbid states, and of the secreted products, according to the manner in which the nervous influence may be modified by remedial and morbific agents—and taking along, also, the exactly corresponding effects of Fear, Loss of Blood, &c., in suddenly augmenting the urine and perspiration, and in inducing purging and convulsion of muscles, we reach the certainty that these effects of the latter are, equally with the former, owing to the exciting and alterative influences of that same protean power, and that it may be brought into *direct* operation as well by causes acting directly upon the nervous centres as when it involves both orders of nerves, p. 107–111, § 227–233¾; p. 230–233, § 422–427; p. 284–287, § 455–459; p. 290–291, § 462–470; p. 295–321, § 476–494; p. 321, § 496, 497; p. 631–632, § 892¾; p. 651–653, § 894–896; p. 665–676, § 902–904; p. 679–681, § 905 *a*. Also, Reflex Action of Nervous System, Mental Emotions, Fear, and the other individual *Passions*, Weeping, Skin, Cold, Heat, Warm Bath, Respiration, Convulsions, Spasmodic Affections, Whooping-Cough, Food, Loss of Blood, Bloodletting, Secretion and Excretion. *Index II.;* Sympathy, Nervous Power, *Index I. and II.*
not a "strainer," as commonly supposed, p. 222–227, § 409 *c*–411; p. 230–233, § 422–427; p. 318, § 493 *d;* p. 631–632, § 892¾; p. 788, § 1032 *a;* p. 801, § 1036; p. 910–911, § 1083, and confirmed particularly through the last preceding references.
its modified action, as denoted by fluctuations of the urine, generally owing to diseases of other organs, especially of the digestive, and induced by reflex action of the nervous system, which disturbs its functions without inducing absolute disease, when the urine
Kidney—*continued.*
should be regarded as a symptom only, like that of the pulse, or the morbid aspects of the tongue, through which some knowledge is obtained of the nature and force of disease in other parts, p. 232–233, § 426, 427. Also, Pulse, Tongue, Amenorrhœa, Urine, *Index II.;* Menstruation, *Index I.* Also, p. 847, § 1058 *s*.
Kiestine,
declared, on authority, to be a "pure illusion," p. 787, § 1032 *a*.

L.

Lactation,
exemplifies the natural instability of the properties of life, which, in being designed for useful ends, becomes the occasion of diseases and of their cure, p. 3, § 2 *b;* p. 61, § 133 *c;* p. 68–69, § 153–156; p. 87, § 180; p. 120–122, § 237–240; p. 352, § 524 *d;* p. 376–380, § 578; p. 662, § 895. Also, Vital Properties, Organic Life, *Index I.;* Youth, Infancy, Vomiting, Pregnancy, *Index II.*
alterative influence of reflex action of the nervous system, excited by the uterus, the efficient cause, *ibid.*, and p. 111, § 233¾; p. 351, § 524 *b*. Also, Metastasis and Repulsion, *Index II.*
considered in connexion with the vital and mechanical doctrines of secretion, and as a proof from analogy, along with the now admitted absence of the constituents of the bile in the blood, that the kidney is not a "strainer," and in its relation, also, to the supposed production of sugar by the liver, p. 783–793, § 1031–1032. Also, the preceding *references*, and references under Kidney and "Strainage," *Index II.*
diverted from its natural state, and the milk altered by mental emotions through direct propagation of the nervous influence, p. 788, § 1032 *a*, and Mental Emotions; Brain, Inflammation of; Remedial Action, *subdivision* Mental Emotions; the individual *Passions*, Secretion and Excretion, Reflex Action, *Index II.*
proof derived from, that sugar does not exist in the blood, p. 785, § 1031 *b*; p. 790, § 1032 *b*.
Lacteals, (See Absorption, *Index I.*)
circulation in, depends upon suction of the heart and their own action, p. 211, § 390 *a;* p. 214, § 392 *c, d*.
exclude the bile, and all intestinal products excepting chyle, unless diseased, and why—and, for like reason, exclude remedial agents, and not liable to in-

Lacteals—*continued.*
flammation like the Lymphatics and Veins—all evincing great Design, p. 99, § 192; p. 129–131, § 277–284, and *references* there; p. 356, § 526 *c*; p. 632, § 892¾ *c*. Also, Lymphatics, Veins, *Index II.* Also, p. 933, § 1089.
allusion to, in connexion with the anatomical relations of the intestinal canal to the nervous system, and Author's doctrine of the operation of Cathartics through alterative influence of reflex action of the nervous system, p. 565.
have terminal orifices, p. 933, § 1089.
Liebig's and Carpenter's mechanical doctrine of the function of absorption, p. 132–133, § 289–292.

Lactic Acid,
not found in the blood, and physiological conclusions, p. 784, § 1031 *b*.

Laughing,
excited in a direct manner through the Will and Mental Emotion, showing how the latter sometimes conspires with the former in determining the nervous influence upon the voluntary muscles, and may be excited through reflex action of the nervous system, as an ultimate result, by tickling the feet, and may then prove fatal—illustrative of the modus operandi of remedial and morbific causes, physical and mental, through alterative influence of direct and reflex nervous action, and of the substantive existence and self-acting nature of the Soul, p. 323–328, § 499–500 *m*; p. 707, § 947; p. 709, § 951 *b–c*; p. 880, § 1074; p. 887, § 1077. Also, Mental Emotions, Joy and Anger, and other individual *Passions*; Brain, Inflammation of; Reflex Action, *Index II.*; Sympathy, Nervous Power, *Index I. and II.*

Lead, Acetate of,
arrests hemorrhage of lungs, uterus, &c., and colliquative sweats, through alterative influence of reflex action of nervous system, since, if absorbed, it would be rendered inert by conversion into another salt, or, if otherwise, the quantity of a grain at a dose, diluted by the mass of blood and other fluids, would not be felt, p. 530, § 837 *c*; p. 577, § 890 *o*.
the modus operandi of Astringents and of other remedies illustrated in the foregoing manner, and by other remedial influences of the acetate of lead, and by comparison with other Astringents and with other things, p. 577–578, § 890 *o*. Also, Astringents, *Index II.*

Leeching,
the philosophy of its effects divided into seven stages, p. 692–698, § 914–928.

Leeching—*continued.*
1st, as in general bloodletting, the first essential effect consists of a contraction of the capillary bloodvessels; but in leeching there is an antecedent vital impression of a very peculiar nature produced upon the extreme vessels to which the leeches are applied, § 915.
2d, an immediate vital contraction of these vessels, arising in part from the foregoing specific impression, and in part from the direct abstraction of their natural stimulus, § 916.
3d, then follows, by continuous sympathy along the vessels (or *continuous influence*, as the Author prefers, p. 322, § 498 *a*), and through reflex action of the nervous system, p. 321, § 496, a propagation of the foregoing changes to the entire system of extreme and capillary vessels throughout the body, and why, § 917.
4th, the larger vessels, sooner or later, participate through the foregoing influences (3) in the contraction, § 918. Also, Sympathy, Continuous, *Index II.*
5th, simultaneously, and at an early stage, the heart is brought under the influence of the reflex action of the nervous system, which increases in a rapid ratio, p. 693, § 919; p. 698, § 933.
6th, during the progress of the foregoing influences and changes they become more or less compounded, the reflex nervous influence which is propagated from the extreme to the larger vessels and the heart institutes reflex influences upon the extreme vessels, while these, in being thus impressed, institute an increased amount of the reflex influence upon the heart and larger vessels, which increases still farther the contraction of the small vessels, and this complex or double circle of sympathies continues to advance till the heart becomes overpowered in its action, and syncope takes place, p. 693, § 920, and *references* there.
7th, the specific artificial impression instituted by leeches at the place of their impression continues to exert a powerful development of reflex action of the nervous system, which is determined with the foregoing effect (2–6) upon the heart and arteries long after the blood has ceased flowing, and, for this reason, the system may be more prostrated by much smaller quan-

Leeching—*continued.*
tities of blood taken by leeching than by general bloodletting, and syncope may ensue some hours after the blood has ceased flowing, p. 693, § 921 *a–c*, and *references* there.—NOTE DD p. 1132.
direct and reflex action of the nervous system the essential cause of all the effects, *ibid.*, and p. 703–711, § 940–952—and which is distinctly shown by the effect of a single leech in relieving ophthalmia, or pleurisy, or amenorrhœa, &c., when applied to the skin, since there is no vascular connexion between the skin and the internal parts, and the quantity of blood too insignificant to affect the volume of the circulating mass. See BLOODLETTING, GENERAL, *Index II.*
the effusion of blood is owing to the specific change instituted by leeches in the vital condition of the extreme vessels, being analogous to the process of secretion, and differing totally in that respect from the results of cupping, although in the latter case larger and far more numerous vessels are divided, and then require the aid of an exhausting receiver, p. 694, § 922 *a*; p. 702, § 939 *b*, *c*.
hence it is evident that cupping-glasses should not be applied in leeching, and for other reasons, p. 702, § 939 *d*.
a remarkable difference, also, between the effects of leeching and of spontaneous hemorrhage, which is also analogous to a secretory process, and may amount to many pounds without much impairing the strength or inducing syncope—owing to a difference in the development of the reflex action of the nervous influence in the two cases, p. 694, § 922 *b*. Also, HEMORRHAGE, SPONTANEOUS, *Index II.*
other special influences may be obtained through the medium of special vital relations which one organ may bear to another, while the auxiliary part will not only co-operate in the development of salutary alterative influences of reflex action of the nervous system, but may itself be thus relieved of disease more effectually than by any other means—as seen in hepatic congestion, when, if leeches be applied to the anus, or septum nasi, the artificial change which is there established is propagated continuously along the mucous tissue of the intestine and up the duct of the liver into the labyrinth of the organ, while, also, the liver is not only thus relieved and brought to institute salutary reflex

Leeching—*continued.*
action of the nervous system, but the continuous impression upon the intestinal mucous tissue institutes other usefully alterative influences of reflex action, and after the manner of Croton oil applied to the tongue, or of suppositories, p. 694–695, § 923 *a–d*. Also, p. 64, § 141 *b*; p. 322–323, § 498; p. 343, § 516 *d*, No. 2; p. 344–345, § 516 *d*, No. 6; p. 349, § 520; p. 350, § 523, No. 7; p. 351, § 524 *a*, No. 2; p. 355–359, § 526 *b*, *c*; p. 526, § 828 *d*; p. 563–564, § 889 *a*; OIL, CROTON; SUPPOSITORIES; SYMPATHY, CONTINUOUS; ALTERATIVES; ANTIMONY, TARTARIZED, *Index II.*
for the foregoing and other reasons, it may be most useful to apply leeches to a part remote from the seat of disease, while in a larger proportion of cases the application should be made near or directly to the affected part, p. 694–695, § 923–924—and the mechanical doctrine of revulsion not to be thought of, p. 695, § 924. Also, METASTASIS and REVULSION, COUNTER-IRRITANTS, REFLEX ACTION OF NERVOUS SYSTEM, *Index II.*
again, the best influences will sometimes follow the application to a distant part between which and the seat of disease there are apparently no particular natural relations, as to the feet in amenorrhœa, and the septum nasi in cerebral affections, p. 694–695, § 923 *b*–924.
operates, in part, upon principle concerned in Counter-Irritation, when the reflex nervous influence is developed by the irritation of the skin, p. 659, § 893 *q*; p. 696–697, § 926, 927 *a*—and the philosophy considered of the salutary effects of frequent and small abstractions of blood by leeches in chronic inflammation—being, besides the influences peculiar to loss of blood, and by leeching, analogous to the philosophy concerned in small and repeated vesications in the same conditions of disease, and closely allied in principle to the continued operation of small and repeated doses of alterative medicines, p. 648–649, § 893 *g*, *h*. Also, p. 649, § 893 *h*; COUNTER-IRRITATION, ALTERATIVES; ANTIMONY, TARTARIZED, *Index II.*
useful when applied over indolent tumours, and often when not of an inflammatory nature, both by changing the morbid action, and particularly by establishing a susceptibility in the tumours to the local or constitutional action of other remedies, as Iodine, Mercury, Vesicants, &c., p. 659, § 893 *q*; p. 684, 905½ *b*; p. 616, § 892½ *f*,

Leeching—*continued.*
often useful only after general bloodletting, in chronic inflammations, which demand the sudden and special physiological influences of the latter remedy to overcome the obstinacy of morbid habit, p. 298, § 476½ *h*; p. 658, § 893 *p*; p. 697, § 927 *a*; p. 711, § 953. Also, Bloodletting, General; Habit, Vital, *Index II.*—but often beneficial in certain mild, though chronic cases, without the general remedy, § 927 *b*.
should never precede general bloodletting when the latter may be more useful, as in all cases of severe inflammations, p. 696, § 925; p. 713–714, § 956–958; p. 729, § 966; p. 733, § 974. Also, p 642, § 892⅘ *i*; p. 658, § 893 *p*; p. 871–872, § 1068 *d*; Bloodletting, General; Inflammation, *Index II.*
most sensibly felt in Infancy, and may then be sufficient when general bloodletting would be indispensable at a later age, as the susceptibility to remedial action is then greatest, and a larger volume of blood is abstracted in the ratio of size, and quickly, &c., p. 696, § 925. Also, p. 67, § 150–151; p. 375, § 576 *e*—but never in the cerebral inflammations and congestions of that age, p. 696, § 925 *c*; p. 733–734, § 974 *c*–975 *b*. Also, Brain, Inflammation of; Inflammation, Infancy, *Index II.*
injurious as an early remedy in the grave forms of visceral congestions and inflammations, p. 729, § 965 *b*, 966.
the nature of its influences considered when excessive, having some peculiarities which differ from the injurious influences that arise from the excessive use of general bloodletting, p. 697–698, § 927 *b*. Also, Bloodletting, General, *Index II.*
may be a remedy for inflammation induced by excessive general bloodletting, p. 698, § 928; p. 774, § 1024 *a*. Also, Bloodletting, General, *Index II.*
like general bloodletting, more salutary than spontaneous hemorrhages even of large extent, when the remedies may be adopted, on account of, in the former case, the specific influence instituted in the extreme vessels of the bitten part, and the consequent special modification of the nervous influence, and, in the latter, the suddenness of its development, p. 298, § 476½ *h*; p. 693–694, § 921–922; p. 702, § 939; p. 770–772, § 1018, 1019. Also, Hemorrhage, Spontaneous; Stomach, Blows upon; Joy and Anger, *Index II.*
the most unfavorable cases for, and where general bloodletting is important, p. 729, § 966.
unlike general bloodletting, leeching may be superintended by the unprofessional, as the quantity of blood abstracted is generally comparatively small, is slowly taken away, and the results slowly manifested, though in Infancy these considerations do not obtain as at later years, p. 696, § 925 *b*; p. 714, § 958 *b*.

Lehmann,
his admissions that Medicine has nothing to hope from Chemistry, p. 779–782, § 1029–1030.
his opinion of Vital Physiologists, p. 795–799, § 1034.
avows that "there is no essential difference between organic and inorganic bodies," *ibid.* Also, Mülder, *Index II.*
his opinion upon the production of animal sugar, &c., p. 783–795, § 1031–1033.
affirms that the component parts of the bile are not found in the blood, in which he agrees with Mülder and Kane, p. 180, § 350¾ *e*; p. 783, § 1031 *b*—and from which, and other facts, the Author reasons to other secretions, p. 784–793, § 1031 *b*–1032.

Leucorrhœa,
its principles of treatment, p. 576, § 890 *n*; p. 688, § 905½ *c*.
best special remedies for, Cantharides internally, Nitrate of Silver externally, p. 688, § 905½ *c*.

Light—continued from *Index I.*,
how it produces sneezing through a compounded series of reflex actions of the nervous system, and employed by Author to illustrate the modus operandi of remedial and morbific agents through alterative influences of the same medium, p. 340–341, § 514 *l*. Also, Iris, Odors, Disgust, Mental Emotions, &c., *Index II.*

Liver—continued from *Index I.*,
does it produce sugar? p. 783–794, § 1031–1033.
objections to hypothesis of double function, p. 789, 790, § 1032 *a*.
supposed effect upon, by pricking medulla oblongata, p. 792, § 1032 *d*.
allowed not to be a "strainer," p. 783, § 1031 *b*. Also, "Strainage," *Index II.*

Loss of Blood, (Bloodletting, *Ind. II.*)
when appropriate, promotes the salutary effects of all other remedies, prevents their morbific effects, and should therefore, when employed, precede all others, and often even to the extent of its

Loss of Blood—*continued.*
repetition, p. 367, § 556 *c*; p. 375, § 576 *c*; p. 550, § 863 *f*; p. 552, § 868 *b*; p. 572–574, § 890 *d–f*; p. 641–642, § 892$\frac{4}{5}$; p. 658, § 893 *p*; p. 713–714, § 956–958; p. 729–730, § 968–969; p. 733–734, § 974–975; p. 736, § 979; p. 739, § 985. Also, BLOODLETTING, LEECHING, *Index II.*
its management in Croup, § 576 *e*, 964 *d*.
leeching may succeed, in *Infancy*, in grave inflammations and congestions of all organs excepting the brain, and in the latter case general bloodletting should be practised, and why, p. 696, § 925; p. 733–734, § 974–975; p. 767, § 1009 *b*, *c*.
the philosophy of its effects wholly referable to alterative influences of direct and reflex action of the nervous system, p. 690–711, § 906–952. Also, BLOODLETTING, LEECHING, *Index II.*
affects profoundly the secretions and the blood itself through alterative influence of reflex action of the nervous system exerted upon the capillary vessels, as may also a mental emotion, p. 703–711, § 940–952 — which should be connected with that condition of the same influence that so alters the action of the sanguiferous vessels in inflammations as to impart the *hardness* and *incompressibility* of pulse, and buffiness and cupping of blood which its loss removes, p. 444–445, § 688 *a–f*; p. 804–805, § 1040. Also, BLOODLETTING, MENTAL EMOTIONS, FEAR, and the other individual *Passions*, PULSE, SECRETION AND EXCRETION, INFLAMMATION, REMEDIAL ACTION, *Index II.*; NERVOUS POWER, SYMPATHY, *Index I. and II.*
its effects through the nervous system illustrated by the Passions and other things, p. 666, § 902 *c*; p. 667–669, § 902 *e–i*; p. 704, § 944 *a*; p. 706–709, § 946 *b*–951. Also, various citations under last general references.
when death is brought on immediately by the ordinary operation of bloodletting, or as it follows leeching, or the passions, it is wholly owing to the prostrating influence of direct and reflex action of the nervous system upon the great organs of life, p. 693–694, § 921–922; p. 703–705, § 942 *b*–944 *b*; p. 706–709, § 947–951. Also, JOY AND ANGER, *Index II.*
like sudden mental emotions, blows upon the epigastrium, shocks from surgical operations, hydrocyanic acid, &c., a small loss of blood may determine the nervous influence with so much violence upon the brain itself as to extinguish life suddenly; as seen in bloodletting after the brain has sustained a shock of the nervous influence, and through that shock all other organs, in cases of falls, p. 709, § 951 *b–d*. Also, STOMACH, BLOWS UPON; HYDROCYANIC ACID, *Index II.*; NERVOUS POWER, *Index I. and II.*
if syncope take place, reanimation is established by stimulants, cold air, snapping drops of cold water upon the face, &c., through their development of an exciting reflex action of the nervous system, p. 338, § 514 *d*; p. 705, § 945. Also, COLD, SKIN, HEAT, FOOD, *Index II.*
Author's *tabular* arrangement of the different tissues and organs, and parts of continuous tissues, illustrating the difference in their vital constitution by their relative liability to inflammation, the relative danger of the disease, and the relative proportion of loss of blood that may be required, as the disease may affect one part or another, p. 69–73, § 160–162. Also, STRUCTURE, *Index II.*
proposal of pricking the heart in persisting cases of syncope originally made by the Author, in *Medical and Physiological Commentaries*, vol. i. p. 178, *note* (1840); *Institutes*, p. 705, § 945.
its operation expounded by Author in *Medical and Physiological Commentaries*, altogether through direct and reflex action of the nervous system—Article BLOODLETTING, p. 121–362, vol. i. (1840). Also, *ibid.*, p. 568–572, where the mechanism and the doctrine of reflex nervous action is specifically set forth as the Author's engine against the Humoral Pathology.
first recorded quantities of blood abstracted, p. 755, § 1004 *c*.
why HIPPOCRATES has not stated quantities, p. 756, § 1004 *d*.
LOVE,
like every other passion, has its own special way of developing and modifying the nervous influence, and directing it upon special parts with well-marked effects, while its local influences of a direct nature generate a reflex action of the nervous system less productive of agreeable results—contradicts the chemical and humoral doctrines in physiology and disease, and goes with the rest in sustaining the Author's interpretation of the modus operandi of remedial and morbific agents, p. 95, § 188$\frac{1}{2}$; p. 107–108, § 227–228; p. 111, § 233$\frac{3}{4}$; p. 326–328, § 500 *g–m*; p. 335–336, § 412–513; p. 417, § 649 *c*; p. 631, § 892$\frac{3}{4}$ *b*; p

Love—*continued.*
709, § 951 *b, c;* p. 891, § 1077. Also, Mental Emotions, Jealousy, and the other individual *Passions,* Disgust, Shame, Friction, Yawning, Sea-Sickness, Remedial Action, Seton, *Index II.*
considered in its distinction between man and animals, p. 900–901, § 1078 *i, k.*

Lungs,
the philosophy and treatment of their various maladies, p. 633–642, § 892$\frac{4}{5}$. Also, Pneumonia, Bloodletting, Counter-Irritants, Inflammation, *Index II.*

Lymph,
as a morbid product, depends upon inflammation, and designed for useful ends, and analogous to suppuration in principle, p. 471–475, § 732–733. Also, p. 546–547, § 862–863.
Becquerel and Rodier's, and Simon's opinion of its dependence on vital laws, p. 800–801, § 1035.

Lymphatics, (See Absorption, *Index I.*)
circulation in, dependent on same causes as in Lacteals, which see, *Index II.*
termination of, in mesenteric veins, led Magendie to the inference that the veins perform the office of absorption, which is contradicted, also, by Design in relation to the general functions of the absorbent and venous systems, p. 128–129, § 269–273; p. 527, § 829. Also, p. 62, § 136; p. 63, § 137 *b, c;* p. 210, § 387; and Circulation of Blood, *Index II.;* Veins, *Index I.*
absorb nothing but what is natural to them, not even pus, p. 99, § 192; p. 129–131, § 227–284, and *references* there; p. 632, § 892$\frac{3}{4}$ *c,* 1088–1089.
participate in the ulcerative process, p. 129, § 272; p. 472–473, § 733 *b–d;* p. 483, § 746 *b,* &c.
like the veins, particularly liable to diffuse inflammation, and supplying in either case a good illustration of *continuous* sympathy, p. 356, § 526 *c;* p. 526–527, § 828 *d, e.* Also, Veins; Sympathy, Continuous, *Index I. and II.;* Lacteals, *Index II.;* Venous Congestion, Venous Tissue, *Index I.*

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Magendie,
his mistake in supposing that the veins perform the office of absorption, p. 128–129, § 269–273; p. 527, § 829. Also, p. 62, § 136; p. 63, § 137 *b, c;* p. 210, § 387, and Veins, *Index I.;* Circulation of Blood, *Index II.*
his opinion of "Vitality" and Inflammation, p. 482, § 744; p. 509 § 810.

Mankind, Unity of—continued from *Index I.,*
briefly considered, p. 906–907, § 1078 *s.* Also, Races of Mankind, *Index I.*

Materialism—continued from *Index I.,*
the chemical and functional doctrines of, p. 882–885, § 1076; p. 894, *note.*

Materia Medica—continued from *Index I.,*
farther illustrations of the principles upon which the Author has founded his Therapeutical Arrangement of, p. 830–831, § 1057 *c;* p. 835–838, § 1057½; p. 851, § 1060; p. 853, § 1061; § 1062, 2 *b,* 854–860, 892¼ *h.*

Measles,
like small-pox, scarlet fever, and mumps, a self-limited disease, and cannot be placed in a better condition for the recuperative law than is done by its own cause, and, like the other affections, illustrates the close analogy between morbific and remedial agents, p. 544–545, § 858; p. 844, § 1058 *i*—and what, also, is generally true of the former in regard to their laws, is about the same in respect to measles. See the Articles. Also, Contagion, Miasm; Causes, Morbific; Remedies, Therapeutics.

Medical Science, Progress of—continued from *Index I.,*
what is apt to be so denominated, p. 795, § 1033 *b.*
its future prospects at the hands of Chemistry, p. 8–10, § 5; p. 14, § 6; p. 203–204, § 367½; p. 779–782, § 1028–1030.
in its present state, intolerant of those who look upon Nature less superficially, p. 12–13, § 5½ *a;* p. 795–799, § 1034—which explains the remote cause that has compelled the Article on the "Rights of Authors," p. 912–920.

Medicine—continued from *Index I.,*
sudden revolutions in, p. 795, § 1035 *b.*

Medicines, Combinations of. See Remedies, *Index II.*

Memory—*loss of,* Note Hh p. 1138.
different in man and animals, p. 901–902, § 1078 *a.*

Menorrhagia,
commonly a sympathetic result, like amenorrhœa, of abdominal diseases, though more frequently than the latter, and the whole condition generally more important, and greater advantages are bestowed by astringents in one case than by emmenagogues in the other, while either equally require the main treatment to be addressed to any existing predisposing disease. See Amenorrhœa, Emmenagogues, Astringents; Causes, Morbific;

Menorrhagia—*continued.*
HEMORRHAGE, SPONTANEOUS; ERGOT, LOSS OF BLOOD, UTERUS, *Index II.*
MENSTRUATION. See *Index I.*
MENTAL EMOTIONS,
see a subdivision, *Mental Emotions*, under REMEDIAL ACTION, where the references to this subject are numerous, and present a variety of physiological, pathological, and therapeutical problems, illustrative of the Author's doctrine of their action through the direct development of the nervous influence, and of developments of reflex action of the nervous system as consequences of the impressions made upon parts remote from the nervous centres by the antecedent direct development; and also the numerous references under the several subdivisions of REFLEX ACTION OF THE NERVOUS SYSTEM, and of NERVOUS POWER (*Index II.*), where the analogies with the foregoing are clearly and variously established—each and all of which, certainly their united force, must ere long sweep away those chemical and physical doctrines, which, though promulgated by Genius of the highest order in the walks of Chemistry, and to which mankind are under profound obligations, have, for that very reason, vitiated all Medical Science, and rendered its practice an empirical art. See SHAME, GRIEF, DISGUST, JOY AND ANGER, HOPE, FEAR, JEALOUSY, LOVE, WEEPING, MICTURITION, LAUGHING, YAWNING, ROOSTING, SNEEZING, MIND, SOUL AND INSTINCTIVE PRINCIPLE, CHEMICAL PHYSIOLOGISTS, *Index II.*; ORGANIC CHEMISTRY, *Index I. and II.*
bear a strict analogy in effects with those of disease, injuries, and physical irritations of the nervous centres, which develop the nervous influence in a direct manner, and are then alone interested with the system of excito-motory nerves or fibres of compound nerves, and farther establish their analogy with the Mental Emotions through the reflex actions of the nervous system that supervene as consequences of the impressions upon distant parts by the direct development, and other resulting circles of complex reflex actions—whose results declare their dependence upon *something*, that they are precisely the same in all the cases, and that, therefore, they are equally due to a common cause, and equally so when physical agents acting upon the skin give rise to exactly the same phenomena, and that since neither the external physical causes
Mental Emotions—*continued.*
nor the brain, nor spinal cord, are transmitted to the affected parts, it is quite logical to suppose that the Mental Emotions are restrained from wandering away from those nervous centres upon which they institute their primary action, and that, if there be any thing of a substantive nature in a blister, or in the stick which inflicts a blow upon the head, and upon which all the distant effects depend, it is equally certain that a substance quite as real, and quite as distinct from the nervous centres, occasions the corresponding results of the mental emotions, and therefore, also, through the same efficient medium—all of which is elaborately apparent in the following sections, p. 101–102, § 201–202; p. 107–108, § 227; p. 109, § 230; p. 111, § 233¾; p. 289, § 461; p. 296, 476 *c*; p. 302, § 481 *b*; p. 315–316, § 492; p. 321, § 496, 497; p. 323–330, § 500 *a–n*; p. 333, § 503–505; p. 336–337, § 514 *b*; p. 338–339, § 514 *d–h*; p. 347–348, § 516 *d*, No. 13; p. 416–417, § 649 *c*; p. 592–593, § 891½ *k*; p. 631–632, § 892¾ *b*; p. 661–663, § 894 *b*–896; p. 666–668, § 902 *b–g*; p. 670, § 902 *l*; p. 675–676, § 904 *b*; p. 679–681, § 905 *a*; p. 704, § 944 *a*; p. 707, § 947–949; p. 709, § 951 *b*, *c*; p. 865–868, § 1076; p. 874–881, § 1071–1075; p. 876–877, § 1072 *a*; p. 886–890, § 1077. Also, the foregoing *Articles*.
as Mental Emotions, therefore, often give rise to alterative influences of reflex actions of the nervous system, they differ in those respects from the *Will*, whose displays of the nervous influence terminate in the voluntary muscles, and without exerting any other effect than that of simple motion, and it is alone interested in excito-motory nerves or fibres of that denomination. See WILL, *Index I. and II.*; NERVES, MOTOR; NERVES, SENSITIVE; NERVOUS POWER, *Index I.*
do not operate upon the brain or other organs in the metaphysical manner as commonly supposed of all the attributes of the mind, nor according to the doctrine of Chemistry, but in no other conceivable way than as appertaining to a substantive self-acting agent exciting the nervous influence and determining it upon other organs, or upon the nervous centres themselves, according to the exact analogies supplied by all physical causes, and like those, also, modifying the nervous influence according to the nature of the individual emotions—the effects of the

Mental Emotions—*continued.*
Will through the same causation concurring in this demonstration, p. 107–111, § 226–233¾; p. 266, § 447 *d;* p. 289, § 461; p. 296, § 476 *c;* p. 298, § 476½ *h;* p. 300, § 479; p. 301, § 480; p. 302, § 481 *b;* p. 304, § 481 *g;* p. 306–308, § 483 *b;* p. 324, § 500 *c, d;* p. 335, § 511; p. 402–403, § 634–635; p. 534, § 846; p. 706–709, § 947–951; p. 631, § 892¾ *b;* p. 661–662, § 894 *b;* p. 745–746, § 990½; p. 865–868, § 1067; p. 878–882, § 1074–1075; p. 887, § 1077.
since, therefore, according to the foregoing references, the *Mental Emotions* and the *Will* develop the nervous influence by their direct action upon the brain, and without the intervention of sensitive nerves, and since, also, the nervous influence, when thus developed by the Passions, brings about precisely the same morbid and curative results as when other things operate through reflex action of the nervous system, it supplies as full a demonstration against any chemical doctrine that may be carried analogically from the supposed positive and negative condition of atoms in the galvanic battery to the double nervous arc; *foregoing references,* and Will, *Index I. and II.*
not only induce and remove disease like all morbific and remedial agents of a physical nature, but, like physical causes, it is one of their most obvious characteristics to determine the nervous influence with such a modifying effect upon the instruments of organic processes as to increase or diminish, or to change the natural condition of the secretions, p. 266, § 447 *d;* p. 289, § 461; p. 296, § 476 *c;* p. 302, § 481 *b;* p. 631–632, § 892¾ *b.* Also, Fear, Jealousy, and the other individual *Passions,* Food, Cold, Kidney, Skin, Remedial Action, *subdivision* Mental Emotions, *Index II.*
having established the strict analogies between the morbific and remedial effects of the various Passions and all physical agents, and that they are all exerted through the medium of the nervous system, and according to the particular nature and intensity of each one, and that they constantly operate not only in a direct manner through the excito-motory nerves alone, and according to direct physical impressions upon the nervous centres, and according to their nature, but that the Passions, like the physical impressions, through their effects upon organs distant from the nervous centres, give rise to alterative influences of reflex action of the nervous system according to the nature of each one, and since none but the Materialist will assume that they operate in any chemical or physical manner, we arrive at the incontrovertible conclusion that all the analogous effects of remedial and morbific agents of a physical constitution are not only carried on through the same causation, but that they are equally destitute of all relation to physics and chemistry, *ut supra,* and the individual *Passions,* Bloodletting, Loss of Blood; Brain, Inflammation of, *Index II.*
an apparently endless variety of problems are presented by the Passions in their independent influences, and which become greatly complicated by their relations to foreign causes, by the variety of ways in which they are brought into operation, by the manner in which they modify the condition of organs so as to predispose them to the morbific action of foreign causes, or, again, defeat or promote the salutary effects of remedies, or as they are directly morbific or remedial themselves, and according to the nature and intensity of each, or by their production through mental sympathy, as in laughing, weeping, and even hiccough, or in that analogous but indefinable influence propagated from one to another, as witnessed in yawning, micturition, &c., but all of which are perfectly resolvable through the Author's doctrine of alterative and variously modified influence of direct and reflex action of the nervous system, evince their subjection to laws as peculiar as are all the phenomena (p. 112–121, § 234 *c*–237; p. 514, No. 7, *parallel columns*); and here the Author will extend the example which occurs at p. 866–867, § 1067, in relation to the influence of Fear upon digestion, and suppose that one of the individuals should reject the food from the stomach, in which case the emotion would simply render the nervous influence an irritant to the mucous tissue of the stomach, while the mechanical irritation of the food would develop, in conjunction with the gastric irritation by the passion, the reflex nervous action which determines the act of vomiting; and the analogy in substantive remote causes, and the sameness of the immediate exciting cause of the paroxysm become abundantly manifest in the fact that the mind itself may subsequently reproduce the act by calling

Mental Emotions—*continued.*
up a recollection of the event, and as described at p. 324, § 500 *c*; p. 547–548, § 863 *d*; p. 666, § 902 *c*, and under the Article DISGUST. See, also, HICCOUGH, HYSTERIA, IMAGINATION, FEAR, JOY AND ANGER, JEALOUSY, LOVE, SHAME, SEA-SICKNESS, WEEPING, LAUGHING, SNEEZING, ROOSTING, WHOOPING-COUGH, PHTHISIS, FOOD, COLD, HEAT, SKIN, SETON.
their influences, and the effects of the *Will*, employed by the Author in demonstrating the substantive existence and self-acting nature of the Soul and Instinctive Principle, p. 876–881, § 1071–1075. Also, WILL, *Index I. and II.*
how regarded in their relations to the higher powers of the mind, p. 877–881, § 1072 *b*–1075.
from all which it appears that every consideration relative to the Mental Emotions — their very nature, the variety of their effects in organic life, physiological, pathological, and therapeutical, the rapidity with which they may institute the changes, the manner in which they modify the operation of physical agents, the anatomical medium through which they exert their effects, denote the total absence of any connexion with the laws which govern the conditions of dead matter, while the complete analogies of their effects with those of physical causes, and the multitudinous variety of means which will arrest some given conditions of disease, and often with great instantaneousness, and in common with mental emotions, show that the physical causes, by this correspondence with mental emotions, are equally independent of chemical and physical laws; and their united force bears an overwhelming testimony in corroboration of what is so abundantly substantiated by the phenomena of the mental causes; nor is there a principle or a fact promulgated by Chemistry of practical application at the bedside of the sick, p. 296, § 476 *c*; p. 302, § 481 *b*; p. 377–380, § 578; p. 547–548, § 863 *d*; p. 664, § 900; p. 666, § 902 *c*; p. 667–669, § 902 *e–g*; p. 679–681, § 905 *a*; p. 707, § 947; p. 709, § 951 *b*; p. 866–868, § 1067; p. 889–890, § 1077. Also, the individual *Passions*, SKIN, COLD, SETON, COUNTER-IRRITANTS, RESPIRATION, &c., *Index II.* Also, p. 95, § 188½ *d.*
their development of the nervous influence by their action upon the brain, and their operation upon distant parts through that influence, as also of the
Mental Emotions—*continued.*
Will, wholly peculiar to the Author, p. 106, § 222 *b*; p. 296, § 476 *c*, and *ut supra*, and REFLEX ACTION OF THE NERVOUS SYSTEM, REMEDIAL ACTION, subdivision *Mental Emotions*; AUTHORS, RIGHTS OF, *Index II.*
MERCURIAL PILL, BLUE. See BLUE PILL, *Index II.*
MERCURIAL REMEDIES,
whether applied to the skin or taken internally, produce their constitutional effects through alterative influence of reflex action of the nervous system, both in their largest and smallest doses, and when their operation is slowly progressive illustrated by natural processes, as contraction of the sphincter muscles, respiration, &c., and by effects of cold applied to the surface, seton, tartarized antimony, &c.—displaying, also, the strict analogy in effects between remedial and morbific agents, and that the former operate by substituting pathological conditions more favorable than those of the latter to the recuperative law, since, when the full constitutional effects of mercury induce inflammation of the parotids, and mouth, and the "mercurial fever," the gravest forms of various diseases disappear as a consequence, and, therefore, when they subside under milder influences, it is still in consequence of milder degrees of analogous changes, p. 66–67, § 148; p. 338–339, § 514 *d–h*; p. 344–345, § 516 *d*, No. 6; p. 524, § 827 *e*; p. 526, § 828 *d*; p. 541, § 853–854 *b*; p. 542–543, § 854 *c*–857; p. 567–569, § 889 *l–mm*; p. 645–647, § 893 *c–e*; p. 661–663, § 894 *b*–896; p. 664–672, § 900–904; p. 678, § 904 *d*; p. 679–681, § 905 *a*; p. 850, § 1059. ALTERATIVES; ANTIMONY, TARTARIZED; CANTHARIDES; HYDROPHOBIA, VIRUS OF; SKIN, COLD; OIL, CROTON; SUPPOSITORIES, LEECHING, *Index II.* P. 930–931, § 1088 *b, c.*
their constitutional effects promoted by other cathartics and by loss of blood, which raise the irritability of the intestinal mucous tissue and of the system at large, through which the influences of the mercurial agent are promoted, p. 367, § 556 *c*. Also, p. 63, § 137 *d, e*; p. 65–66, § 143 *c, d*; p. 67, § 149–151; p. 73, § 163, and IPECACUANHA, *Index II.*
MERCURY, CHLORIDE OF. See CALOMEL, *Index II.*,
illustrates the modus operandi of Astringents by its comparative effects in cholera infantum with those of the latter in diarrhœa, &c., p. 576, § 890 *l.*

Metamorphosis,
philosophy of, p. 902, § 1078 *p.*
Metaphysicians—continued from *Index I.*,
should take for their basis, in intellectual philosophy, the physiological facts which demonstrate the substantive existence and self-acting nature of the Soul. See Soul and Instinctive Principle, *Index II.*
identify the Soul and Instinctive Principle, p. 895, § 1078 *b;* p. 889, § 1078 *h.*
Metastasis, Revulsion, and Repulsion,
have been interpreted upon no intelligible principle, but which depend upon alterative influences of reflex action of the nervous system—illustrating the practical consequences of unsound doctrines, p. 351–352, § 524 *b–d;* p. 652–656, § 893 *n;* p. 695, § 924. Also, Counter-Irritants, Elaterium, Lactation, Mumps, Uterus.
Miasm, Vegetable,
the cause of the numerous varieties of fever, and often of inflammations and venous congestions, and modify the character of each according to the particular modes of vegetable decomposition and recombination of the elements as brought about by varying temperatures, climate, season as to moisture and dryness, and other chemical influences, p. 417–418, § 650; p. 424, § 662; p. 480–481, § 743; p. 490, § 758; p. 493–494, § 765–767; p. 496, § 773; p. 497–498, § 777–780; p. 510–512, § 813–817. Also, Causes, Morbific; Remedies, Remedial Action, *Index II.*
is generally the predisposing cause only, but may be also the only exciting cause, p. 420, § 654 *a;* p. 421–422, § 654 *c–657 a;* p. 497, § 779.
does not produce disease in the surfaces upon which it operates, unless through reacting influences of the reflex law of the nervous system, and through which, also, as in the case of cold, the morbific influences are propagated upon all other parts from the surface upon which the primary impression is made, p. 221–222, § 657 *a;* p. 426, § 666 *a.* Also, Causes, Morbific; Hydrophobia, Virus of; Skin, Cold, Seton, Sphincter Muscles, Whooping-Cough, Alteratives; Antimony, Tartarized; Predisposition, &c., *Index II.* Also, § 891½ *g*, 1088 *b*,
like the virus of small-pox, measles, &c., may establish a permanently protective influence against repetitions of the same disease—intermittent and yellow fevers, for example—but with the difference that the susceptibility is more likely to return in the case of the
Miasm, Vegetable—*continued.*
fevers unless the subjects continue to reside under the influence of their predisposing causes, p. 364, § 544, 545; p. 365–366, § 550–555; p. 368, § 559, 560; p. 370, § 566 *b;* p. 425, § 664. Also, Small-pox; Diseases, Self-limited; Vital Habit, Acclimation, *Index II.*
cannot produce disease—such as yellow fever, plague, malignant cholera, dysentery, &c.—that may be communicable, nor can a contagious disease be generated in others by any other cause than the animal product which arises from each disease respectively—a fundamental law which is without exception, p. 27, § 52; p. 419–420, § 653; p. 842–843, § 1058 *f.*
its morbific action promoted by various causes which increase the susceptibility of the system, with illustrations from Cathartics, Bloodletting, &c., p. 524, § 827 *e;* § 961 *a;* § 970 *c;* and Remedies, Acclimation, *Index II.*
often predisposes the system to the malign action of other morbific causes, renders the consequent diseases more dangerous and complicates their treatment, as the malignant cholera, small-pox, measles, scarlatina, and increases their epidemic character, § 630 *e;* § 652 *b;* p. 420, § 654 *a;* p. 425, § 663; p. 510–511, § 813–816; p. 553, § 870 *aa;* p. 604–606, § 892 *m–p.*
illustrates the philosophy of Vital Habit, p. 364, § 543–548; p. 365–366, § 550–554; p. 368, § 559, 560; p. 370, § 566 *b.*
may establish the predisposition quickly, and although the subject pass immediately from its farther influence, an explosion of disease may follow at once as a consequence, or only after weeks or months, p. 420, § 654 *a;* p. 421, § 655 *c, d.* Also, Hydrophobia, Virus of; Predisposition, Alteratives, *Index II.*
Micturition,
its phenomena as arising from mental sympathy, and in connexion with those of Fear, noises, &c., illustrative of the remarkable effects of mental emotions in organic life through the nervous influence, and of its diversified modifications according to the precise nature of the emotion, p. 534, § 844; p. 630–632, § 892¾; also, Jealousy, Mental Emotions—and when regarded in connexion with the corresponding effects of cold applied to the surface, and of cathartics, bloodletting, &c., an identity of a common proximate cause is established, only, in the case of the men-

Micturition—*continued.*
tal emotions the nervous influence is developed in a direct manner, and in which the excito-motory nerves are primarily interested, while in the other cases the sensitive nerves take the initiatory step, and reflex action is the consequence—all concurring together in advancing the Author's doctrine of the modus operandi of morbific and remedial agents, physical and mental, through alterative influences of direct and reflex action of the nervous system. See REMEDIES; CAUSES, MORBIFIC; REMEDIAL ACTION, MENTAL EMOTIONS, &c., *Index II.*

MIGRATION,
its want of analogies with the acts of reason employed to demonstrate the distinction between the Soul and Instinctive Principle, p. 896, § 1078 *d*; p. 898, § 1078 *q*.

MILK,
its production originally dependent upon alterative influence of reflex action of the nervous system, whose point of departure is the uterine system, p. 231–232, § 424; p. 351, § 524 *b*. Also, KIDNEY, SECRETION AND EXCRETION, WEEPING, FOOD, FEAR, COLD, UTERUS, ORGANS OF GENERATION, *Index II.*; YOUTH, NERVOUS POWER, *Index I. and II.*
rendered "morbid" by mental emotions, through alterative influence of nervous power, p. 788, § 1032 *a*.
"we analyze healthy and morbid milk, and yet we are ignorant of the substances whose admixture we term *casein*," p. 780, § 1029.
disquisition as to the origin of its saccharine matter, p. 785, § 1031; p. 788–791, § 1032 *a*, *b*.

MIND—continued from *Index I.*,
its influence upon the action of remedial agents, p. 865–868, § 1067. Also, MENTAL EMOTIONS, the individual PASSIONS, *Index II.*; WILL, *Index I. and II.*
its phenomena far more multifarious than of inorganic nature, and more, therefore, is known of the former than of the latter, p. 182, § 350¾ *g*. Also, p. 84, § 175 *bb*; p. 112–121, § 234 *b*–237; SOUL AND INSTINCTIVE PRINCIPLE, MENTAL EMOTIONS, the individual PASSIONS, *Index II.*; WILL, *Index I. and II.*
subject to the law of Vital Habit, and under complex influences, p. 369-370, § 566–568; p. 894–895, § 1078 *b*.
suffers permanently from premature education, but not so with Instinct, and through reflex nervous influence

Mind—*continued.*
from too much or improper food in early life, p. 370, § 568; p. 894–895, § 1078 *b*. Also, INFANCY, CHILDHOOD, YOUTH, FOOD, UTERUS, VOMITING.
what constitutes *Ideas*, and employed to illustrate the substantive existence and self-acting nature of the Soul, p. 906, § 1078.
its modus operandi inscrutable, *ibid.*
contrast between, and Instinct, in the infancy of man and animals, p. 892–895, § 1078 *a*, *b*; p. 904–906, § 1078 *q*.
contrasted with the Instinctive Principle as they respect the relative varieties in the main central portion of the nervous system, p. 896, § 1078 *d*; p. 897–898, § 1078 *e*; p. 903–906, § 1078 *q*.
various other contrasts and analogies between. See SOUL and INSTINCTIVE PRINCIPLE.
the brain, or its equivalent, co-operates with, in all intellectual and instinctive acts, but more so in the latter case, p. 894, § 1078 *b*; p. 903–906, § 1078 *q*.
identified by metaphysicians with Instinct, p. 895, § 1078 *b*; p. 899, § 1078 *h*.
the doctrines of Materialism in relation to, p. 882–886, § 1076; p. 894, *note*.

MORBID ANATOMY. See ANATOMY, MORBID, *Index II.*

MORBIFIC CAUSES. See CAUSES, MORBIFIC, *Index II.*

MORTIFICATION—continued from *Index I.*,
results from a profoundly morbid condition of the formative stage of inflammation, when not owing to direct violence as variously inflicted, p. 447, § 736 *a*, *b*.
dead parts removed from living through the vital process of ulceration, p. 477, § 736 *c*.
imputed, in inflammations, by the prevailing physical doctrines, to stagnation and coagulation of blood, p. 484–485, § 748, 749.

MOTION—continued from *Index I.*,
after apparent death, in voluntary and involuntary muscles, and the philosophy of, p. 403–404, § 637; p. 805, § 1041.
dependent upon properties implanted in all parts, p. 806, § 1042. Also, VITAL PROPERTIES, ORGANIC LIFE, *Index I.*

MUCUS,
Table of parts by which it is produced according to their physiological differences, with corresponding varieties in the product, p. 218, § 406. Also, p. 61, § 133 *a*, *b*; p. 62–63, § 135–137.
its varieties depend in its morbid as well as natural states upon the physiologi-

Mucus—*continued.*
cal peculiarities of different parts of the mucous tissue, and their exact modifications in disease, p. 436, § 682 *b*; p. 452, § 693; p. 455, § 694¾.
denotes a greater intensity of inflammation, and greater danger, and calls for more vigorous yet cautious practice when intermixed with blood, p. 572–576, § 890 *c–n.*
its redundancy generally denotes inflammation, and it is then equivalent in principle to suppuration, with which it often alternates, and with lymph, in some parts of the mucous tissue, p. 452, § 693; p. 471, § 732 *a.*
is increased, or diminished, or altered from its natural condition through reflex action of the nervous system in all parts beyond the seat of the direct operation of foreign causes, and more or less so upon their direct seat of action through reverberated nervous influences; and affected in the foregoing manner by the passions or other causes acting directly upon the nervous centres through direct development of the nervous influence, and through reflex action when the changes are induced by disorders of other and distant parts, p. 422–423, § 658; p. 465–467, § 715–719; p. 478–479, § 740–741. Also, Bile, Lactation, Weeping, Food, Kidney, Skin; Water, Hot; Antimony, Tartarized; Fear, Mental Emotions, &c., *Index II.*
a peculiar modification of, diagnostic of pneumonia, p. 436, § 682 *b.*
operates as a depletive means, but far less so than most other products of morbid processes, excepting from the lungs, being also a result of the recuperative law, p. 471, § 732 *b*; p. 546–551, § 862–863; p. 633–634, § 892⅘ *a*; p. 635–640, § 892⅘ *h.*
Mucous Tissue—continued from *Index I.*,
the important part, in one of its arrangements, upon which remedial agents make their impressions, and from which emanate those modified conditions of reflex action of the nervous system through whose variously diversified alterative influences, according to the nature of the agent, &c., bring about all their changes in parts remotely situated, and constantly, also, through reacting nervous influences upon the tissue which is the direct seat of remedial or morbific action, and the philosophy of all of which may be found in the physiology of respiration, where the point of departure for the reflex action of the nervous system is the same tissue in the
Mucous Tissue—*continued.*
lungs, and where the exciting cause is of such an insensible nature that it is difficult to decide upon its real character, and also farther coincident with other natural processes, as may be seen through the references under the *Articles* subjoined, p. 66–67, § 148; p. 359, § 527 *a, b*; p. 361, § 529 *b*; p. 415–417, § 649 *a*–650; p. 421–422, § 657–658; p. 530, § 837 *b*; p. 542, § 854 *c, d*; p. 545, § 860; p. 547–550, § 863 *d–e*; p. 554, § 871; p. 561, § 888 *c*; p. 563–566, § 889 *a–i*; p. 567–569, § 889 *l–mm*; p. 571, § 890 *b*; p. 575–576, § 890 *g–n*; p. 628–629, § 892⅘ *q–t*; p. 634–641, § 892⅘ *b–i*; p. 687–688, § 905½ *c.* Also, Respiration, Sphincter Muscles, Youth, Skin, Cold, Heat, Counter-Irritants, Seton, Exercise, Ulcers, Iris, Phthisis, Sea-Sickness, Heart, Kidney, Stomach, Emetics, Vomiting, Disgust, Odors, Cathartics; Hydrophobia, Virus of; Roosting, Yawning, Antispasmodics, Reflex Action, Remedial Action, &c., *Index II.*; Nervous Power, Sympathy, *Index I. and II.*
Table, referring to the different modifications of its organic conditions in different parts, and indicative of their relative liability to inflammation, p. 70, Table II.—another, showing its relative liability to that disease compared with other tissues, Table I.—another, showing the relative danger when affected with high inflammation as it forms a component part of different organs, and as the same disease may affect other tissues in their compound relations, p. 72, Table III.—another, showing the exigencies for bloodletting in high inflammation, according to its last foregoing relations, and comparatively with other tissues in their connexion with compound organs, Table IV.
the difference in the vital constitution of its different parts where it occurs continuously, as from the mouth to the lungs, and from the mouth to the anus, variously illustrated by the corresponding variety in its products, by the natural changes in some of its parts, by the differences in effects that arise from remedial and morbific agents, whether acting immediately upon its surface, or through alterative influences of reflex action of the nervous system, or through direct development of the nervous influence by the Passions, and according to the special modifications of disease; and the variety in its vital constitution farther

Mucous Tissue—*continued.*
shown as the tissue occurs in parts remote from each other, and as it sympathizes in remote parts through reflex action, p. 61–66, § 134–143; p. 67, § 149–151; p. 70, TABLE II.; p. 107–111, § 227–233¾; p. 374, § 576 *d*; p. 415–417, § 649 *a–c*; p. 436, § 682 *b*; p. 452, § 693; p. 522–523, § 827 *b–d*; p. 547–550, § 863 *d*; p. 555, § 872 *a*; p. 566, § 889 *i*; p. 571, § 890 *b*; p. 575–576, § 890 *g–n*; p. 634–641, § 892⅘ *b–i*; p. 661–663, § 894 *b*–896; p. 666–672, § 902 *a*–904; p. 840–841, § 1058 *d*, *e*; p. 854, § 1061; p. 856–857, § 1063; p. 862–864, § 1066.
Table showing its relative liability with that of other tissues to sympathize continuously in their several parts, p. 354, § 526 *a*. Also, SYMPATHY, CONTINUOUS, *Index II.*
Table showing its relative liability compared with other tissues to morbid sympathies, through reflex action of the nervous system, in organs remote from each other, p. 353, § 525 *a*.
its own sympathies in parts remote from each other, and with other tissues, § 512, 514 *f*, 523, no. 7, 527 *a*–529, 689 *l*, 889, 892⅘ *b–i*, 902 *g*, 904 *bb*.

MÜLDER,
applies *catalysis* in expounding secreted products, in which he does not agree with LIEBIG, p. 178–182, § 350¾ *a–f*; p. 226, § 409 *j*.
decides that the component parts of the bile and of other secretions are not to be found in the blood, and that we have "no knowledge whether the bile proceeds from the blood or from the secreting organ," p. 180–182, § 350¾ *e*. Also LEHMANN, *Index II.*
maintains that there is no essential difference between living and dead matter, p. 179–182, § 350¾ *c–f*; also, LEHMANN, *Index II.*—and yet he does not, p. 189–190, § 350¾ *n*, *parallel columns*—but believes with Dr. CARPENTER and others that *Carbon*, *Oxygen*, *Hydrogen*, and *Nitrogen* are endowed with life, p. 178, § 350¾ *a*; p. 181–182, § 350¾ *f*.
upon the Soul, p. 183, § 350¾ *gg*.

MÜLLER,
the chief expositor of the physiological laws of reflex action of the nervous system, p. 341–342, § 514½ *b*; p. 362, § 530.
nevertheless, fails of applying them pathologically and therapeutically, is at fault, like MARSHALL HALL, in his physiological attributes of the nervous influence, adopts the physical doctrine of Absorption, and, like Dr. HALL,

Müller—*continued.*
patronizes the Humoral Pathology, p. 283, § 452 *b*; p. 320, § 494 *dd*.

MUMPS,
occasions inflammation of the testes and mammæ through alterative influences of reflex action of the nervous system, and exemplifies the disposition of tissues of analogous organization and function to sympathize with each other, and is an example of the *metastasis* of Authors, p. 59, § 129 *i*; p. 351–352, § 524 *b*, *c*; p. 353–354, § 525; p. 652–653, § 893 *n*. Also, METASTASIS, INFLAMMATION; CAUSES, MORBIFIC; REFLEX ACTION, &c., *Index II.*; NERVOUS POWER, SYMPATHY, *Index I. and II.*

N.

NARCOTICS—continued from *Index I.* See, also, OPIUM, *Index I. and II.*
limited in a group to such as relieve pain and induce sleep, p. 583, § 891 *a*, *b*.
greatly overrated, p. 584, § 891 *c*; p. 715–720, § 960 *a*; NOTE H p. 1117.
considerations relative to their injurious tendencies, and the neglect of more important means, *ibid.*
very deficient in curative virtues, and illustrations, p. 584, § 891 *d*.
their modus operandi like that of all other remedies and of all morbific causes—that is to say, when their effects extend beyond their direct seat of operation, it is through alterative influences of reflex action of the nervous system—supplying examples, also, of the remarkable manner in which the nervous influence is variously modified and rendered alterative according to the nature of the causes by which it is brought into action, p. 107–111, § 227–233¾; p. 309–310, § 484 *b*, Nos. 5, 6; p 321–341, § 496–514 *m*; p. 567, § 889 *k*; p. 585, § 891 *e*; p. 589–590, § 891 *o*, *p*; p. 592–593, § 891½ *k*; p. 661–663, § 894–896; p. 665–675, § 902–904; p. 679–681, § 905 *a*. Also, ANTISPASMODICS, *Index II.*
an example derived from Aconite applied to the skin in its sudden relief of neuralgia of the sciatic nerve, to show its operation through alterative influence of reflex nervous action, p. 838, § 1057½.
analogy between the sedative effect exerted upon the nervous influence by Narcotics when developed by reflex action, and as developed in a direct manner by certain Emotions of the Mind, p. 296, § 476 *c*; p. 302, § 481

Narcotics—*continued.*
b; p. 589–590, § 891 *p;* p. 592–593, § 891½ *k;* p 670, § 902 *l.* Also, Hiccough, Hysteria, Antispasmodics, Mental Emotions, Opium, Food, *Index II.;* Nervous Power, *Index I. and II.*
the variety in their virtues, respectively, of much practical advantage, p. 585, § 891 *f.*
their effects generally increase, at first, by frequent repetition, but subsequently decrease, though may be a good deal maintained by substituting one for another during their continued use, *ibid.*, and § 981 *s.*
directly sedative, as shown by their lessening morbid sensibility and irritability, and by the manner in which they counteract spasmodic affections, p. 590, § 891 *q;* p. 592–593, § 891½ *k;* p. 828–833, § 1057 *a–i.*
their greatest use, to produce *sleep* and relieve *restlessness*, though in this they may fail, or aggravate the trouble, when other means would be efficient, p. 586, § 891 *g, h;* p. 715–721, § 960 *a, b.*
their next great use, to relieve morbid states of *irritability*, through which opium arrests diarrhœa, &c., with practical illustrations, p. 572, § 890 *a;* p. 576, § 890 *l;* p. 587, § 891 *i.*
next in order comes *pain*, for which they are mostly esteemed, and most abused —the *symptoms* commonly demanding very different remedies, such as loss of blood, blisters, warm bath and fomentations, p. 587–589, § 891 *k–p;* p. 715–721, § 960 *a, b.*
their effects often counteracted by a peculiar stimulating nervous influence developed by *pain*, so that quantities are often admissible that would be fatal in health, p. 590, § 891 *r*—and again by a very different modification, as in the delirium of drunkenness, p. 590, § 891 *r;* p. 734, § 976 *b.*
the less important the part, the safer will they be, in a general sense, or where disease is not profound, p. 587–589, § 891 *k–p.*
less morbific in chronic than acute diseases, where, also, they are most successful, *ibid.*

Nauseants,
a subdivision of Author's group of Sedatives, p. 830, § 1057 *d.*
prolific in examples of the operation of remedial and morbific agents through alterative influence of reflex action of the nervous system, of which Croup supplies one of the most obvious, where no amount of Tartarized Antimony or Ipecacuanha will moderate

Nauseants—*continued.*
the symptoms till nausea takes place, when immediately a melioration often sets in, and advances rapidly when vomiting ensues—and, as the latter is admitted to depend upon reflex action of the nervous system, it goes with the former fact in showing that the disease is equally overcome by the same influence determined upon the mucous tissue of the larynx—while, also, the mineral and vegetable substance, in alike subduing the disease, demonstrates, like a thousand other analogous cases, the absurdity of the chemical and every other physical rationale, p. 336–337, § 514 *b, c;* p. 365–366, § 551–554; p. 486, § 750 *b;* p. 532–533, § 841; p. 666–670, § 902 *b–m;* p, 675–676, § 904 *b.* Also, Antimony, Tartarized; Alteratives, Disgust, Mental Emotions, *Index II.*

Negro,
his color, and that of other races, considered, p. 393, § 610; p. 907, § 1078 *s.* Also, Races of Mankind, *Index I.; Medical and Physiological Commentaries*, vol. ii., p. 640.

Nervous Power—continued from *Ind. I.*
its existence, attributes, and functions, (whatever it may be, or if a better name can be substituted), as well as of the Organic Properties, more demonstrable than any thing relative to mere physics, p. 76, § 167 *a;* p. 79–81, § 167 *g–*169 *f;* p. 84, § 175 *b;* p. 85–87, § 175 *d–*177; p. 88, § 184 *b*, 185; p. 95–96, § 189 *b;* p. 111–121, § 234–237; p. 326–331, § 500 *g–o.*
although its existence as an agent is variously demonstrable, as above, it is sufficiently so by considering that all motions have a positive exciting cause—the lining membrane of the heart and bloodvessels is stimulated by the blood, the retina by light, the mucous tissue of the alimentary canal by food and bile, &c.—therefore the analogies prove that the muscles of respiration, the iris, the sphincter muscles, and all other muscles, must have an analogous cause, and when the variety in the results is considered, as arising from mental as well as physical causes, the great fallacy of the chemical rationale becomes glaringly apparent—and so of the Soul and Instinctive Principle, p. 62, § 136. Also, p. 107–122, § 226–240, and foregoing *references*, and Soul and Instinctive Principle, *Index II.*
nevertheless, the Author expresses himself as entirely opposed to all speculations as to the nature of such a power, and it is wholly unimportant whether

Nervous Power—*continued.*
it be conceded that some other unknown influence (always excepting the chemical rationale) is exerted at the extremities of the excito-motory nerves, since, whatever it may be, it will in no respect affect the Author's application of the physiological laws of the nervous system in resolving the great problems in Pathology and Therapeutics, p. 117–118, § 234 *g*; p. 330, § 500 *nn*; p. 878–879, § 1073 *a*—but, in accepting this part of the alternative, it must be made to explain in some intelligible manner the endless variety of effects that ensue upon the operation of natural, morbific, and remedial agents, physical and mental (many of which are incapable of being absorbed), according to the nature of each one, and shown to be of some practical use in medicine, but which is perfectly resolved by the Author's doctrine of special *modification* of the nervous power by the several causes respectively. The term *power* is sanctioned by long usage and by late eminent writers, as Liebig, for example, when speaking of the functions of the nervous system (p. 158–171, Nos. 51–62, 65, 69, 70, 72–74, 79, 81, 87–91, *parallel columns*); but the present writer prefers the term nervous *influence* (as he says of *continuous sympathy*, p. 322, § 498 *a*), which expresses his meaning exactly, and is exempt from all hypotheses, p. 88, § 184 *b*; p. 107–110, § 227–232; p. 112, § 234 *b*; p. 302, § 481 *b*; p. 305, § 482; p. 309–314, § 484–489; p. 323–332, § 500; p. 333, § 503; p. 334, § 509; p. 405–412, § 638; p. 530, § 837 *b*; p. 547–550, § 863 *d*; p. 661–663, § 894 *b*–896; p. 665–670, § 902 *a–m*; p. 706–709, § 947–951.
operates upon the minute structure of organs, whether vascular, muscular, &c., and both by reflex and direct action, as it may be excited in one case through sensitive nerves, or in the other by causes acting directly upon the nervous centres, and through which action upon their organic states all the secreted products, and all the other natural conditions, are increased or diminished, or turned from their natural conditions, or again restored, in all parts beyond the seat of the direct operation of all causes which disturb its natural action—all organs being rendered preternaturally susceptible of the influences of the nervous system by their morbid state; and where it is not directly affirmed that all the foregoing results are due to

Nervous Power—*continued.*
influences of reflex or direct action of the nervous system upon the organic states, it is so by an obvious implication, for brevity's sake, founded upon the Author's universal application of the foregoing principle—and, farther, the nervous influence may prove a simple *excitant* or *depressant*, or, what is far more important, and distinctly and variously shown by unequivocal demonstration, and which can be expounded by no other philosophy, and which is fundamental in the Author's, it may, according to the nature of the causes, physical and mental, that bring it into preternatural action, undergo as great a variety of *modifications* as there are special virtues in the several causes, remedial or morbific, rendering it variously alterative, and from which results through the influences exerted by this protean agent upon the instruments of action the endless variety of changes that occur in the solids and fluids remote from the direct seat of operation in the case of all physical agents, and always so in the case of the Passions or other causes affecting the nervous centres, and even in the case of the direct seat of action the changes in the direct seat are apt to be consequent upon reflex actions coming either through the appropriate nerves of the part, or depend upon reflex actions excited by remote organs, p. 61, § 133 *c*; p. 63, § 137 *d*; p. 65, § 143 *c*; p. 66–67, § 148; p. 101–102, § 201–203; p. 106–118, § 222–234; p. 125, § 245; p. 215, § 395; p. 226–227, § 410–411; p. 230–233, § 422–427; p. 250, § 441 *c*; p. 262, § 446 *a*; p. 264–270, § 446 *d*–447 *d*; p. 286, § 456 *a, b*; p. 301–302, § 481; p. 305–310, § 483–485; p. 323–336, § 499–512; p. 337, 338, § 514 *c, d*; p. 339–340, § 514 *h*; p. 344–345, § 516 *d*, No. 6; p. 347, § 516 *d*, No. 10; p. 348, § 516 *d*, No. 13; p. 351, § 524 *a*; p. 356–358, § 526 *d*; p. 359, § 527 *a, b*; p. 421–423, § 657–658; p. 451–452, § 692; p. 486, § 750 *b*; p. 483–484, § 746 *c*; p. 506, § 803, 804; p. 546–550, § 862–863 *f*; p. 563–566, § 889 *a–g*; p. 585, § 891 *e*; p. 589–590, § 891 *p*; p. 592–593, § 891½ *k*; p. 612–613, § 892½ *a, b*; p. 631–632, § 892¾; p. 637, § 892⅘ *d, e*; p. **642**-648, § 893 *a–g*; p. 661–663, § 894–896; p. 666–672, § 902 *b*–904 *a*; p. 679–681, § 905 *a*; p. 692–695, § 915–924; p. 697–701, § 927–928; p. 703–710, § 940–952; p. 831–833, § 1057 *f–k*; p. 862–864, § 1066; p. 865–868, § 1067; p. 875–877, § 1072 *a*; p. 886–891, §

Nervous Power—*continued.*
1077. Also, Reflex Action, Mental Emotions, Remedial Action.
exalts the condition of all organic compounds, solid and fluid, including the blood; a law profoundly concerned in pathology and therapeutics, § 226, 232, 399, 405, 446 *a*, 461, 485, 488½, 512, 733 *h*, 746 *c*, 846, 902, 952.
explanatory specifications of the mechanism through which the nervous power operates in its function of reflex action, for the purpose of applying it to the interpretation of the modus operandi of all remedial and morbific agents upon parts beyond the seat of their direct operation, and also of its limitation in other cases to the motor nerves, and as the cause of all the physiological changes in the solids, and of all increased or otherwise modified secretions in parts not the immediate subjects of other agents through its various influences upon the instruments of organic processes, and of its modifications according to the nature of its exciting causes, as well, also, for proving the substantive existence and self-acting nature of the Soul and Principle of Instinct, p. 101–102, § 201–202; p. 106, § 224—227; p. 112, § 234 *b*; p. 116–117, § 234 *f*; p. 282, § 451 *d*; p. 285–287, § 455 *d*–459 *a*; p. 290–295, § 462–475½; p. 300, § 479; p. 309–310, § 484 *b*, Nos. 5 and 6; p. 321, § 496, 497; p. 323–328, § 499 *a*–500 *m*; p. 331–341, § 500 *o*–514 *n*; p. 344–345, § 516 *d*, No. 6; p. 348, § 516 *d*, No. 13; p. 416–417, § 649 *c*; p. 421–423, § 657–658; p. 465–466, § 715; p. 483–484, § 746 *c*; p. 592–593, § 891½ *k*; p. 661–663, § 894–896; p. 665–670, § 902 *a*–*n*; p. 679–681, § 905 *a*; p. 703–710, § 940–952; p. 873–881, § 1069–1075; p. 886–891, § 1077; § 111–113, 224, 488½, 524 *d*, no. 7, 891½ *g*, 893 *a*.
nevertheless, the Author endeavors to show that the functions of organs in the organic life of Animals are carried on, like the analogous ones in Plants, by properties inherent in all parts, and that the nervous power or nervous influence contributes nothing more toward the functions of the nutritive and other secretory vessels than that of exerting a modifying, or exciting, or depressing influence upon them, through which the products are perfected in their character, or increased or diminished; but these instruments of life are constantly liable to preternatural influences of the nervous power, and of an endless variety, and there is no function in the natural

Nervous Power—*continued.*
state of the body, no condition of disease, no action of remedies, in which the nervous influence does not participate (p. 54–55, § 109 *b*–117; p. 284–287, § 454 *c*–459; p. 289, § 461; p. 483–484, § 746 *c*), while organs in their compounded condition are more manifestly under its perpetual harmonizing influence through the impressions made upon their minute structure — it being, therefore, the Author's doctrine that the nervous influence is merely an *exciting* or *modifying* cause of the organic functions, and whenever he speaks of that influence as a *cause* of certain effects, or objects to its application as a *cause* of any of the processes of life, he always means in the former case that it influences the processes of life, and in the latter that these processes are carried on by causes or properties inherent in all parts, p. 23, § 34–38; p. 24, § 41, 42; p. 54, § 109 *b*; p. 66–67, § 148; p. 75–76, § 167 *a*; p. 110, § 233; p. 222–227, § 409 *c*–411; p. 284–286, § 454–457; p. 289, § 460–461½; p. 294, § 475; p. 295–296, § 476 *b*; p. 313–315, § 488–489; p. 317–318, § 493; p. 421–423, § 657–658; p. 483–484, § 746 *c*; p. 353, no. 7. Vital Properties, Organic Life, *Index I.*; Respiration, Sphincter Muscles, &c., *Index II.* § 990½ *a*, *b*.
is the agent through which the Will and Mental Emotions operate. See Will, *Index I. and II.*; Mental Emotions, and the individual *Passions*, *Index II.*; Nervous Power, *Index I.*
but there is an essential difference in the influence of the nervous power upon organs that are less interested, or not at all, in the essential processes of organic life, where, as in voluntary motion, respiration, contraction of the sphincter muscles, peristaltic movements, the nervous power is the only immediate stimulus which brings the muscles into action; though here, also, the motions are accomplished by inherent powers, p. 110, § 233, and many of the preceding references. Also, Vital Properties, Nervous Power, *Index I.*; Sphincter Muscles, Respiration, Iris, Cathartics, *Index II.*
its development *direct* when the Will or Mental Emotions operate, or any disturbances affect the nervous centres, and *indirect* when the exciting influences proceed from other parts through sensitive nerves or fibres, and the transmitted impression develops the nervous influence—consti-

Nervous Power—*continued.*
tuting reflex action of the nervous system or remote sympathy—both orders of nerves or fibres of compound nerves being always engaged in the latter case, while in the former, when the Will and Passions operate, the excito-motory nerves or fibres are alone concerned, and the influence alone centrifugal, unless the Passions, as is common, and diseases of the nervous centres, &c., institute impressions upon distant parts that are reverberated upon the nervous centres, when the nervous influence, although direct at its incipient movement, may establish a complex circle of reflex actions, and undergo modifications of its alterative influence, not only according to the nature of its primary exciting cause, but according, also, to that of the particular natural constitution of different parts, and any present modified condition of parts upon which its influences may fall, since, also, any preternatural condition of an organ, whether rendered temporarily so by disease, or only temporarily disturbed by the nervous influence (as in sneezing from a strong light impinging upon the retina, p. 327, § 500 *i*; p. 333, § 504; p. 340–341, § 514 *l*), is equivalent to influences propagated in a like manner by the action of remedial and morbific agents, and will modify the nervous influence in a corresponding manner; and upon this reflected influence and its modifications depend the diseases of organs that grow out of each other, and the nature of the affections as they may spring up consecutively, and in connexion with the constitutional nature of different parts, or as they may conspire together in aggravating or relieving the conditions of each other, p. 59, § 129 *h*, *i*; p. 61–68, § 133–152; p. 73, § 163; p. 101–102, § 201–202; p. 107–119, § 224–234; p. 282–284, § 451–453; p. 285–286, § 455; p. 296, § 476 *c*; p. 321, § 496, 497; p. 323–328, § 499–500 *l*; p. 331–334, § 500 *o*–510; p. 347–348, § 516 *d*, No. 13, 517; p. 429–430, § 674 *d*; p. 526, § 828 *d*; p. 539, § 848; p. 592, § 891½ *k*; p. 642–648, § 893 *a*–*g*; p. 661–663, § 894–896; p. 665–676, § 902 *a*–904 *b*; p. 679–681, § 905 *a*; p. 692, § 914–921; p. 698–699, § 930–935; p. 703–710, § 940–952; p. 745–746, § 990½; p. 831–833, § 1057 *f*–*h*; p. 838, § 1057½; p. 865–868, § 1067; p. 874–881, § 1071–1075; p. 886–891, § 1077.

Nervous Power—*continued.*
"exhaustion of," an hypothesis without foundation, p. 805, § 1041.
when remedies properly applied (as with morbific causes) develop the *alterative* action of the nervous influence, it is not commonly by exciting *disease* in parts which are the direct seat of their operation, but when this result ensues it is mostly through reflex action of the nervous system directed upon the seat of their operation—though prominent exceptions occur in the case of Counter-Irritants, p. 66–67, § 148; p. 336, § 514 *b*–*h*; p. 416–417, § 649 *c*; p. 421–423, § 657–658; p. 483–484, § 746 *c*; p. 522–523, § 827 *b*, *c*; p. 862–864, § 1066. Also, Miasm, Skin, Cold, &c., *Index II.*
considered in its slowly progressive operation through reflex action of the nervous system, when brought into effect by agents belonging to Author's group of Alteratives, and analogous means, both physical and mental—the same being also true of the slowly progressive operation of morbific causes, p. 111, § 233½, 233¾; p. 285–286, § 455 *d*–*f*; p. 333, § 503–506; p. 339, § 514 *g*; p. 344–345, § 516 *d*, No. 6; p. 365, § 551; p. 366, § 556; p. 416–417, § 649 *c*; p. 420–424, § 654–661; p. 532, § 841; p. 547, § 863 *d*; p. 551, § 877; p. 568–569, § 889 *m*, *mm*; p. 646–649, § 893 *e*–*h*; p. 661–663, § 894–896; p. 668–670, § 902 *g*–*m*; p. 675–676, § 904 *b*; p. 679–681, § 905 *a*. Also, Sphincter Muscles, Alteratives; Hydrophobia, Virus of; Small-pox, Miasm, Predisposition, *Index II.*
may operate profoundly with *morbific*, but little with remedial effect, long after the exciting cause is withdrawn, p. 66–67, § 148, 150; p. 111, § 233½, 233¾; p. 285–286, § 455 *d*–*f*; p. 333, § 503–506; p. 339–340, § 514 *g*, *h*; p. 344–345, § 516 *d*, No. 6; p. 364, § 545; p. 365, § 549, 550; p. 368, § 558, 560; p. 416–417, § 649 *c*; p. 420–424, § 654–661; p. 425–427, § 664–666; p. 532, § 841; p. 542, § 854 *c*–*e*; p. 668–669, § 902 *g*; p. 707–708, § 949.
the incorporation of the cerebro-spinal and ganglionic systems in all parts renders them all the constant subjects of direct and reflex nervous influence; but in the natural state of the body this influence is not strongly pronounced, excepting in certain instances, as respiration, the contraction of the sphincter muscles, the motions of the iris, of the stomach and intestine, and of the heart; but

Nervous Power—*continued.*
otherwise mostly so when morbific and remedial agents and the mental emotions operate, p. 55, § 111–117; p. 58–59, § 129 *a, i;* p. 61, § 133 *c;* p. 62–67, § 136–151; p. 87, § 177; p. 88, § 184–185; p. 101–102, § 201–202; p. 106–112, § 222–234; p. 116–117, § 234 *f, g;* p. 253, § 441 *d;* p. 262–268, § 446 *a*–447 *d;* p. 284–290, § 454–461½ *c;* p. 296, § 476 *c;* p. 323–341, § 499–514; p. 344–345, § 516 *d*, No. 6; p. 348, § 516 *d*, No. 13; p. 350–353, § 524; p. 354–362, § 526–530; p. 508–509, § 807–811; p. 537–539, § 847 *e*–848; p. 563–565, § 889 *a–g;* p. 592–593, § 891½ *k;* p. 642–650, § 893 *a–i;* p. 657, § 893 *p;* p. 661–681, § 894–905; p. 692–709, § 914–951; p. 745–747, § 990½ *a, b;* p. 804, § 1040; p. 865–868, § 1067; p. 874, § 1071; p. 877–881, § 1072 *b*–1075; p. 886–890, § 1077, 891½ *g.*

other strongly marked examples of reflex action of the nervous system, and of an alterative nature, occur in natural mutations of the body from Infancy to Youth, and others in other natural conditions to which the system is incidentally liable, as in gestation and lactation. See Youth, Lactation, Uterus, Organs of Generation, Milk, *Index II.*

the entire dependence of respiration upon reflex action of the nervous influence coincides with the dependence of the act of vomiting upon the same causation, and carried by the Author through a chain of analogies consisting of the various modifications of respiration, of vomiting as produced by emetics of various kinds, by loss of blood, by tickling the fauces, by tobacco applied to the soles of the feet, by pregnancy, by shock of falls, by mental emotions, &c., and the divers influences and results according to the nature of the cause, and other coincidences supplied by the iris, sphincter muscles, skin, cold, suppositories, tetanus, &c., which depend upon other modifications of the nervous influence through reflex action, and the analogies supplied by the will in voluntary motion—all carried to the interpretation of all the effects of active emetics and cathartics, both remedial and morbific, and by the same analogies, their effects, when they fall short of vomiting or purging, or other prominent results that arise from larger doses, through *alterative* influences of reflex action of the nervous system, upon parts beyond the seat of their direct operation, and

Nervous Power—*continued.*
against the chemical and physical doctrines of operation through absorption—and all this chain of analogies applied to the modus operandi of all other remedial and morbific causes, physical and mental, while the same interpretation of all the others is sustained by other special demonstrations in immediate connexion with a large number of the several things respectively, p. 66–67, § 148; p. 110, § 232; p. 323–341, § 499–514 *m;* p. 344–345, § 526 *d*, No. 6; p. 347–348, § 516 *d*, No. 13; p. 421–423, § 657–658; p. 526, § 828 *d;* p. 532–533, § 841; p. 542–543, § 854 *c–f;* p. 547–550, § 863 *d;* p. 563–566, § 889 *a–g;* p. 568–569, § 889 *m, mm;* p. 592, § 891½ *k;* p. 631–632, § 892¾ *b;* p. 661–663, § 894–896; p. 666–672, § 902 *b*–904 *b;* p. 679–681, § 905 *a;* p. 703–710, § 940–952; p. 831–833, § 1057 *f–g;* p. 838, § 1057½. Also, Stomach, Nauseants, Skin, Cold, Shower Bath, Tetanus, Disgust, Syncope, and the several Articles under Generalization of Reflex Action of the Nervous System, *Index II.*

examples of its effects in subduing violent inflammations, augmenting and altering the natural secretions, and of variously and suddenly modifying the condition of morbid fluid products, and the condition of the blood, when brought into operation by Mental Emotions, p. 296, § 476 *c;* p. 230–232, § 422 *b*–424; p. 335–336, § 512 *a, b;* p. 630–632, § 892¾ *b;* p. 709–710, § 951 *b*–952; p. 865–868, § 1067; p. 877–878, § 1072 *b.* Also, Milk, Sweat, Urine, Food, Weeping, Mental Emotions, *Index II.*; Sudorifics, *Index I.*

is the exciting cause of all diseases which spring up as consequences of each other; but the secondary affections, one or more, may be very different from the primary, depending, in part, upon the peculiar constitution of different tissues, or parts of a tissue, p. 62–68, § 135–152; p. 109, § 229; p. 339–340, § 514 *h;* p. 465–469, § 715–722; p. 483–484, § 746 *c.* Also, Causes, Morbific; Inflammation, Skin, Tobacco, Seton, *Index II.*

expounds the philosophy of *Metastasis* and *Revulsion.* See Metastasis, *Index II.*

may operate upon the organic constitution of the nervous centres, and thence upon the heart, stomach, &c., with a suddenly fatal effect, through reflex action of the nervous system, as with

Nervous Power—*continued.*
blows upon the epigastrium, surgical operations, hydrocyanic acid, &c., or directly through its sudden and violent determination upon the brain, as in the case of joy and anger, when it may act by suddenly destroying the life of the brain, and also farther exemplified by the sudden determination of syncope, and the consequent sudden interruption of pleurisy, &c., through direct and reflex action of the nervous system, and equally acts upon all other parts of the nervous system, p. 107–111, § 226–233¾; p. 296, § 476 *c;* p. 298, § 476½ *h;* p. 300, § 479; p. 301, § 480; p. 302, § 481 *b;* p. 304, § 481 *g;* p. 306–308, § 483 *b;* p. 320, § 494 *dd;* p. 324, § 500 *c, d;* p. 334–335, § 509–511; p. 402–403, § 634–635; p. 534, § 844; p. 704, § 943 *a*–944 *a;* p. 707, § 947; p. 709, § 951 *b–d;* p. 831–833, § 1057 *f–g;* p. 858, § 1057½; p. 862–864, § 1066; p. 865–868, § 1067; p. 878–881, § 1074–1075; p. 887, § 1077. Also, Joy and Anger, Mental Emotions; Serpents, Virus of; Stomach, Blows upon; Pain, Oxygen, Opium, Sedatives (*Aconite*), Neuralgia, Antispasmodics; Brain, Inflammation of; Bloodletting, Loss of Blood, *Index II.;* Will, *Index I. and II.*—Note Q p. 1122.

its opposite influences upon the sensibility of nerves through reflex action of the nervous system the cause and cure of pain (when not the direct result of causes operating locally) and according to the nature of the means by which it is brought into operation, whether by morbific causes, or sedatives, loss of blood, &c., and equally relieved through the same influence by mental emotions, and according to their nature, p. 296, § 476 *c;* p. 302, § 481 *b;* p. 323–324, § 500 *c;* p. 584–585, § 891 *d, e;* p. 587–590, § 891 *k–s;* p. 592–593, § 891½ *k;* p. 831–832, § 1057 *f;* p. 838, § 1057½; p. 862–864, § 1066. Also, Pain, Sedatives (*Aconite*), Neuralgia, Antispasmodics, Bloodletting, Poultices, *Index II.*

applied through alterative influence of reflex action of the nervous system to the modus operandi of Cinchona, Loss of Blood, and of other things of whose mode of operation we are said to be ignorant, and in connexion with illustrations drawn from the modus operandi of a *Seton*, and where, also, under the several references, the organic influences of remedial agents through the instrumentality of nervous action and the philosophy which

Nervous Power—*continued.*
concerns their substitution of transitory pathological conditions for the more profound, is summarily presented, p. 596–597, § 892 *b, c;* p. 676–681, § 904 *c*–905 *a.* Also, p. 67, § 149–151; p. 73, § 163; p. 108–110, § 227–232; p. 542, § 845 *c–e;* p. 554, § 871; p. 592–593, § 891½ *k;* p. 661–663, § 894–896; p. 664–665, § 900–901; Bloodletting, Remedies, Remedial Action, *Index II.;* Nervous Power, *Index I.*

influences very profoundly the functions of secretion and excretion, whether brought into preternatural action by physical agents, or loss of blood, or mental emotions, and is always the cause of the redundances that may arise and the changes they may undergo in parts beyond the seat of the direct action of physical causes, and all other causes through its modifying influences upon the immediate instruments, § 113, 224, 226, 399, 446 *a,* 461, 485, 489, 493 *cc,* 512, 524, no. 7, § 657–658; p. 631–632, § 892¾; p. 668–669, § 902 *g, h;* § 893½; § 943 *a, b;* Secretion and Excretion, Bile, Sweat, Milk, Weeping, Fear, Jealousy, Skin, Kidney, Cold, Heat; Water, Hot; Food, Tea, Emetics, Bloodletting, Loss of Blood, Mental Emotions, *Index II.;* Sudorifics, *Index I.*

exerts the same influence in the production of animal heat as upon other secretions, p. 262–270, § 446–447; p. 807–808, § 1044–1045. Also, p. 68, § 152 *a;* p. 245, § 440 *c;* p. 250–251, § 441 *c;* p. 335–336, § 512 *a, b;* p. 339, § 514 *h;* p. 365, § 889 *g;* p. 579–580, § 890½ *d;* Organic Heat, *Index I.;* Hybernating Animals, Tea, *Index II.*

employed by the Author to expound the dependence of the first act of respiration through reflex action of the nervous system, whose centripetal source is the skin. See Reflex Action of the Nervous System; also, Skin, Syncope, *Index II.*

is the immediate cause of syncope as arising from loss of blood, and of subsequent restoration, and supplies analogies for the Author's doctrines in relation to the nervous influence as connected with Pathology and Therapeutics. See Syncope, Loss of Blood, Mental Emotions, *Index II.*

exerts its effects, in modifying the condition of the solids and fluids, upon the capillary vessels, and in developing muscular motion upon the indi-

Nervous Power—*continued.*
vidual fibres, &c., p. 54, § 109 *b*; p. 220–227, § 409 *b*–411; p. 355, § 526 *a*; p. 804–805, § 1040. Also, Causes, Morbific; Remedies, Remedial Action, &c., *Index II.*; Nervous Power, Vital Properties, Organic Life, *Index I.*
hardness and *incompressibility* of pulse, and buffing and cupping of blood, in inflammations, depend upon its modifying influence upon the sanguiferous organs, while the loss of blood, or a mental emotion, will quickly change its influence and render it subversive of those conditions, p. 444–445, § 688 *a–f*; p. 708–710, § 951–952 *b*; mistaken for *Galvanism*, § 409 *hh*, *k*, 493 *cc*; 893 *a*; 500 *k*, *m*, *nn*, *o*; 893½. Note Y, p. 1130.
direct and *reflex*, employed as the principal basis in demonstration of the *substantive existence* and *self-acting nature* of the *Soul* and *Instinctive* Principle, p. 873–881, § 1069–1075; p. 886–891, § 1077.
determines the act of roosting and of sleeping in the erect posture, and in a manner analogous to its action upon the sphincter muscles, p. 890–891, § 1077. Also, Sphincter Muscles, Alteratives, Suppositories, Grief, Hope, *Index II.*; p. 325, § 500 *dd*.
recent observations upon, confirming important principles in these *Institutes*, p. 803–808, § 1039–1045.
is not a movable substance, *in transitu* from part to part, but, like the principle of Light, is every where diffused through its appropriate medium, and, like that principle, is brought into operation by exciting causes, and with every variety of effect according to the nature of the causes, nor is there any greater difficulty in understanding its imputed modifications than the polarization of light, or any other attributes which the Author assigns it than such as appertain to Light, p. 80, § 169 *b*, *d*; p. 84, § 175 *b*, *bb*; p. 88, § 184 *b*; p. 114–120, § 234 *e*–235; p. 330, § 500 *nn*; p. 334, § 507; p. 670, § 902 *k*.
Nervous System. See Nerves; Nerves, Motor; Nerves, Sensitive, *Index I.*
anatomical account of, and of its uses, and precautions to be observed in experiments upon—with a reference to Author's application of direct and reflex action of, to the modus operandi of all morbific and remedial agents beyond the seat of their direct operation, embracing in this application the natural interchange of actions among all parts which is carried on through

Nervous System—*continued.*
reflex actions of the nervous system, and for applying the same to the propagation of disease from one part to another, and for resolving the operation of *Mental Emotions* and the *Will* through direct development and instrumentality of the nervous influence, and as more fully set forth in other places, p. 284–362, § 454–530; p. 661–681, § 894–905; p. 692 711, § 915–952.
perfects or *animalizes* the constitution of all organic compounds, solid and fluid, including the blood; a law profoundly concerned in pathology and therapeutics. *See this at* p. 1038.
is the medium through which all parts of the organic system are maintained by its reflex actions in harmonious relations, and, although in constant operation among all parts, its manifestations are not strongly pronounced except in particular functions, as in respiration, the motions of the heart and intestines, the motions of the iris, &c., or as brought into action by special causes, as in deglutition, and when its reflex action starts the urine as excited by cold, or the milk at the time of parturition, or by Mental Emotions when its displays are very various and strongly manifested, and by the Will; but is brought into preternatural operation by all morbific and remedial agents, and is the immediate exciting cause of diseases and their cure in all parts beyond the seat of the direct action of morbific and remedial agents, and of diseases that ensue upon each other; and, if our Chemical friends continue to apply the laws of the science which they cultivate to the modus operandi of remedial and morbific agents, they must accept the absurdity of supposing that all the foregoing natural results of the nervous influences are equally chemical, and deny to organic actions (that is, Nature) all participation in the work of cure, p. 54–55, § 111–117; p. 58–59, § 129 *a*, *i*; p. 61, § 133 *c*; p. 62–67, § 136–151; p. 87, § 177; p. 88, § 184–185; p. 101–102, § 201–202; p. 106–112, § 222–234; p. 226, § 409 *k*; p. 295, § 475½; p. 253, § 441 *d*; p. 262–268, § 446 *a*–447 *d*; p. 284–290, § 454–461½ *c*; p. 296, § 476 *c*; p. 301, § 481 *b*; p. 318–341, § 493 *cc*–514; p. 344, § 516 *d*, No. 6; p. 348, § 516 *d*, No. 13; p. 350–353, § 524; p. 354–362, § 526–530; p. 465–469, § 715–722; p. 508–509, § 807–811; p. 537–539, § 847 *e*–848; p. 563–565, § 889 *a–g*; p. 592–593, § 891½ *k*; p.

Nervous System—*continued.*
642–650, § 893 *a–i*; p. 657, § 893 *p*; p. 661–681, § 894–905; p. 692–709, § 914–951; p. 745–747, § 990½ *a, b*; p. 804, § 1040; p. 865–868, § 1067; p. 874, § 1071; p. 877–881, § 1072 *b*–1075; p. 886–890, § 1077, § 891½ *g*.
all remote effects of the Mental Emotions, and of the Will, and of physical agents applied to the nervous centres, and of all diseases of those centres, and of the nerves, are consequences of the nervous influence, developed at first in a *direct* manner, though all but the Will are generally followed by reflex actions, p. 107, § 227; p. 109, § 230; p. 670–671, § 902 *l*–903; p. 733–734, § 973–975. Also, Mental Emotions, Sympathy (experiments), *Index II.*; Will, *Index I. and II.*
experiments upon, mostly by A. P. W. Philip, to determine the "Laws of the Vital Functions," in the relations it bears to the Heart and Vessels of Circulation, p. 295–310, § 476–485; p. 311–315, § 487–489—and to the Voluntary Muscles, p. 310–315, § 486–489—and to the Alimentary Canal, p. 315, § 490, 491—and to the Lungs, p. 315, § 491; with practical applications by the Author to Pathology and Therapeutics, and introduced for the sole purpose of applying them to the interpretation of the effects of all morbific and remedial agents beyond the seat of their direct action, and of the Passions, through alterative influences of reflex action of the nervous system in the former case, and of primarily direct and secondarily reflex in the latter, and of the naturally concerted actions among all parts, their disturbances of each other, &c., *ibid.*, and throughout a greater part of the work.
the varieties of sympathy or reflex action as conducted through the medium of the nervous system, and various physiological illustrations, p. 321–335, § 495–511—and the physiological laws of sympathy or reflex action of the nervous system introduced for the purpose only of applying them as stated in the preceding subdivisions, p. 335–362, § 512–530.
generalization of its laws as applied by the Author to interpret the modus operandi of morbific and remedial agents, both physical and mental, as aforesaid, and from which arise all the changes in the solids and fluids as a consequence of the alterative influence exerted by the nervous action upon the various series of capillary vessels, and showing specifically that this action, both direct and reflex, is

Nervous System—*continued.*
the fundamental cause not only of increased secretions so far as the function does not depend upon other stimuli, but of the various modifications which the secretions undergo in disease, according to the nature of the cause by which the nervous influence is excited, whether physical or mental, p. 230–231, § 422–423; p. 289, § 461; p. 631–632, § 892¾; p. 668–669, § 902 *g, h*; p. 704, § 943 *a, b*. Also, Fear, Jealousy, Weeping, Tea, Food; Water, Hot; Secretion and Excretion, Mental Emotions, Remedial Action, *Index II.*; Nervous Power, Sympathy, *Index I. and II.*
exerts the same influence in the production of animal heat as upon other secretions, only in the former case it is simply an excitant, while in the latter it increases, diminishes, and modifies their condition in an endless variety of ways, according to the nature of the exciting causes, p. 262–270, § 446–447; p. 807–808, § 1044–1045. Also, p. 68, § 152 *a*; p. 245, § 440 *e*; p. 250–251, § 441 *c*; p. 289, § 461; p. 335–336, § 512 *a, b*; p. 339, § 514 *h*; p. 365, § 889 *g*; p. 483–484, § 746 *c*; p. 579–580, § 890½ *d*. Also, Organic Heat, *Index I.*; Hybernating Animals, *Index II.*
Brown-Séquard's interesting and ingenious discoveries in relation to spinal cord, p. 802–803, § 1037.
acts as a whole in its natural state so far as the great nervous centres are engaged in developing motion or otherwise influencing or modifying actions and their results in organic and animal life, however much certain parts may hold a predominating power, and the great sympathetic system derives a concurrent action from the cerebro-spinal, and therefore experiments made upon isolated portions with a view to their independent functions are liable to falsify Nature, p. 11–12, § 5½ *e–f*; p. 54–55, § 110–117; p. 287–289, § 459–461; p. 292, § 473 *a*; p. 293, § 473 *c*; p. 296–298, § 467½ *a–h*; p. 303, § 481 *e–f*; p. 306–308, § 483 *b, c*; p. 357–358, § 590–591.
mistakes in regard to reflex action from confounding results of experiments on *trunks* of nerves with those upon their expanded extremities, p. 338, § 514 *d*; p. 347, § 516 *d*, No. 10; p. 520–521, § 826 *c, d*. Also, *Medical and Physiological Commentaries*, vol. i., p. 507, 563–566.
an intimate connexion established be-

Nervous System—*continued.*
tween the organs of organic and animal life by the intercommunication of the cerebro-spinal and ganglionic systems and the consequent interchanges of reflex nervous action, p. 54–55, § 110–117; p. 107, § 224; p. 110, § 232; p. 284–287, § 454–459; p. 341–353, § 514½–524 — and hence the convulsions of the voluntary muscles which ensue upon intestinal irritation and upon spasm of the stomach, and various other resulting consequences of a reciprocal nature, p. 347–348, Nos. 11–13, &c.; p, 642, § 893 *a.*
subject, like all other organs, to a determination of direct and reflex nervous influence upon its own organization when developed by the Passions, or by inflammation, or injuries, or mechanical or other physical irritations of the nervous centres; but its own affections in this respect are of difficult analysis, p. 109, § 230; p. 356–358, § 526 *d;* p. 709, § 951 *c;* p. 831–832, § 1057 *f, g.* Also, Neuralgia, Opium, Sedatives, Antispasmodics; Brain, Inflammation of; Mental Emotions, Joy and Anger, and the other individual *Passions*, Anæsthetics, Oxygen, Pain; Serpents, Virus of; Hydrocyanic Acid; Stomach, Blows upon; Nervous Power, *Index II.*
the nervous influence may be determined with such sudden violence upon the brain as to instantly extinguish life, though doubtless, also, the same influence is propagated simultaneously upon all the organic viscera, p. 107–111, § 226–233⅔; p. 298, § 476½ *h;* p. 300, § 479; p. 301, § 480; p. 304, § 481 *g;* p. 306–308, § 483 *b;* p. 320, § 494 *dd;* p. 324, § 500 *c, d;* p. 334–335, § 509–511; p. 402–403, § 634, 635; p. 534, § 844; p. 709, § 951 *c;* p. 865–868, § 1067; p. 879–881, § 1074–1075; p. 887, § 1077. Also, Joy and Anger; Stomach, Blows upon, *Index II.*
a great misapprehension of Marshall Hall's in supposing "all convulsive affections to be *diseases* of the true spinal or excito-motory system," and that "the spinal marrow, *exclusive* of the cerebrum, is the source of animal life," and that "the *irritability* of the muscles of organic life depends, probably, on the ganglionic system," and his mistake in contradicting an important experiment by A. P. Wilson Philip, p. 296–297, § 476½ *b;* p. 306–308, § 483 *b, c;* p. 357–358, § 526 *d;* p. 467–468, § 719. Also, p. 11–12, § 54 *e, f;* p. 54–55, § 110–117; p. 287–290, § 458–461½; p. 292, § 473
Nervous System—*continued.*
a; p. 296, § 476 *c*, 476½ *b;* p. 298–299, § 476 *h*–477 *a;* p. 300, § 479; p. 303, § 481 *e, f;* p. 357–358, § 526 *d;* p. 590–591, § 891½; p. 592–593, § 891½ *k;* and Convulsions, Hysteria, Mental Emotions, *Index II.*—nor does the Author acquiesce in his doctrine that "the *Soul sends forth emissaries and plenipotentiaries which convey its sovereign mandates* along the voluntary nerves to muscles subdued to volition," p. 77, § 167 *f.*
diseases of the brain and spinal cord are apt to give rise to great disturbances in organs of organic life, but not to convulsions unless effusion or disorganization happen, but which are commonly dependent on simple irritations of the nervous centres, p. 334, § 508; p. 357–358, § 526 *d;* p. 590–591, § 891½ *b;* p. 592–593, § 891½ *k;* p. 733–735, § 974 *c*–976.
its painful affections, when situated internally, occasioned and relieved by alterative influences of reflex nervous action upon the sensibility of the nerves, and through the same influence when dissipated by mental emotions, and according to the nature of the means by which it is brought into operation, p. 584–585, § 891 *d, e;* p. 587–590, § 891 *k–s;* p. 592–593, § 1057½. Also, Sedatives (*Aconite*), Opium, Poultices, Antispasmodics, Bloodletting, Nervous Power, *Index II.*
is constantly charged with the nervous power or nervous influence, or whatever name may be most acceptable, which is not *in transitu,* a movable substance, but, like the principle of light, is every where diffused through its appropriate medium, and, like that principle, is brought into operation by exciting causes, while, also, the polarization of light supplies some analogy to the Author's supposed modifications of the nervous influence according to the nature of the causes by which it is brought into preternatural operation, p. 114–115, § 234 *e.*
it has been seen in a preceding subdivision that it is exceedingly difficult to determine by experiments the special functions of any part of the brain or of particular nerves or fibres as they may influence the *organic* functions, and doubtless, in a general sense, the phenomena as manifested in health and disease are entitled to a large ground of reliance, p. 115–119, § 234 *f*–235; p. 309–310, § 484 *b,* No. 5; p. 413–414, § 640; p. 434, § 679; p. 442, § 686 *d;* p. 541–542, § 854 *b;*

Nervous System—*continued.*
and in respect to the question before us we may appeal to what was accomplished by our predecessors (deny it as we may), in inferring the existence and many of the laws of reflex action of the nervous system from natural phenomena alone, p. 290, § 463 *a, b*; p. 295–296, § 476 *b*; which brings us to the Author's immediate object—that of having inferred different series of excito-motory nerves or fibres of compound nerves for the fulfilment of several special functions, one, for example, for *common* sensation, another for *specific*, a third for *sympathetic*, another for voluntary motion, another for the glandular organs, &c., p. 100–103, § 197–204; p. 280–283, § 450–451; p. 330, § 500*nn*; though it cannot be satisfactorily inferred from the simple phenomena in health or disease whether there be any special excito-motory nerves or series of fibres destined for influences upon the glandular or other fluid products, p. 230–232, § 422 *b*–424; p. 335–336, § 512 *a, b*; p. 630–632, § 892¾ *b*; and an experiment by Claude Bernard of pricking the floor of the fourth cerebral ventricle discredits all analytical conclusions upon the question of excito-secretory nerves, but very greatly so upon many others of a specific nature, p. 792–793, § 1032 *d*, and, doubtless, about the only reliable amount of experimental inquiry as to the influence of the nerves upon the secretions was supplied by A. P. W. Philip, as published in the *London Philosophical Transactions* for 1815 and 1817, and of which a summary abstract relative to our subject occurs at p. 314–315, § 489; p. 317–318, § 493 *a–d*. Also, p. 264, § 446 *c*; p. 289, § 460, 461; and Hybernating Animals, *Index II.*
its mechanism and laws of reflex action upon which is founded the Author's physiological demonstration of the substantive existence and self-acting nature of the Soul and Instinctive Principle, p. 873–874, § 1070–1071—and physiological examples of the reflex action, and of the Will in its simply *direct* action, and of the Mental Emotions in their operation through *direct* development of the nervous influence and the subsequent institution of *reflex* actions, and the application of the whole to the foregoing object, and to the explosion of the doctrines in materialism, p. 874–892, § 1072–1077; p 904–906, § 1078 *g–r*.
relative structure and other physiological
Nervous System—*continued.*
conditions of the main central part in the infancy of man and animals, as implied by their intellectual and instinctive habits, respectively, p. 892–895, § 1078 *a, b*; p. 904–906, § 1078 *q*.
a concurrence of action between the main central portion and the Soul and Instinctive Principle, p. 892, § 1078.
the central part of, less subservient to the Soul than to the Instinctive Principle, p. 894, § 1078 *b*; p. 903–906, § 1078 *q*.
its varieties in the principal central portion employed to distinguish the Soul from the Instinctive Principle, p. 896, § 1078 *d*; p. 897–898, § 1078 *e*; p. 903–906, § 1078 *q*. Also, Soul and Instinctive Principle, *Index II.*
Neuralgia,
its sudden relief by Aconite when applied along the course of an affected nerve demonstrative of the modus operandi of remedies through alterative influence of reflex action of the nervous system, and of the modification of that influence according to the nature of the exciting cause, and that the nervous influence may be determined with alterative effect as well upon the organic constitution of any part of the nervous system as upon other organs, and, farther, shows that pain is relieved by that influence, p. 838, § 1057½. Also, Antispasmodics, Opium, Sedatives, *Index II.*
Nitric Acid,
applied as a *pediluvium*, subverts syphilis and hepatic diseases, and increases the secretion of bile, through alterative influence of reflex action of the nervous system, p. 530, § 837 *c*—while "our astonishment is great that the bile is not more frequently affected by the various medicinal agents put into the stomach"—but far less so than that the highly irritable heart should escape, were there any foundation for the doctrine of operation by absorption, p. 527, § 829. Also, Sulphuric Acid; Lead, Acetate of; Silver, Nitrate of; Opium, Cold, *Index II.*
Nitrous Oxide Gas,
employed, in connexion with oxygen and other things, to show, in part, upon chemical grounds, that anæsthetics are not absorbed, but that they produce their constitutional effects through alterative influences of reflex action of the nervous system—the philosophy being the same as in respiration when the reflex action is excited by an inappreciable irritation of

Nitrous Oxide Gas—*continued.*
the pulmonary mucous tissue, p. 522–523, § 827 *b-d*; p. 862–864, § 1066. Also, Respiration, Emetics, Stomach, Oxygen, *Index II.*; Nervous Power, *Index I. and II.*
Nux Vomica. See Hydrocyanic Acid, *Index II.*

O.

Odors,
the physiology of vomiting from, &c., through reflex action of the nervous system, employed by the Author in illustrating the modus operandi of all morbific and remedial agents through alterative influences of direct and reflex nervous action; and for the same purpose, also, and to show how an endless variety of impressions from slight causes and upon various parts, and from various causes incapable of absorption or chemical action, and coming from mental as well as physical sources, will institute, through complex circles of reflex actions, a common ultimate effect, such as vomiting, or other results, and how, when instituted by mental emotions, the impression which is primarily made upon a distant part will institute reflex actions that result in violent manifestations—all of which is exemplified in the case of offensive odors in their production of vomiting, whose primary impression is made upon the olfactory nerve, and thus transmitted to the brain, from whence the nervous influence is propagated upon the mucous tissue of the stomach, which it irritates after the manner of an emetic, when this impression is returned to the nervous centres and thence reflected upon the abdominal muscles and muscular coat of the stomach, the former of which are thrown into convulsive action and the action of the latter violently reversed—and again, when a strong light gives rise to sneezing, whose primary impression is made upon the retina, when the nervous influence is reflected from the brain through excito-motory fibres of the nasal branch of the fifth pair of nerves upon the Schneiderian membrane, which it irritates after the manner of snuff, when this impression is returned to the nervous centres through sensitive fibres of the same nasal branch, and thence reflected with convulsive effect upon the abdominal muscles, but in a different manner from the odor—and again, as an offensive spectacle gives
Odors—*continued.*
rise to vomiting, the rationale being the same as that for the odor, with the difference that in the case of the spectacle the primary impression, as in the case of sneezing, comes through the optic nerve—or yet again, as when the mind itself will occasion vomiting by calling up the recollection of the odor or the spectacle, when the mind is the only agent concerned, but the remaining process the same as in the other cases—these analogies, with numerous others supplied by other affections of the mind, and along with their morbific and curative effects, being then carried by the Author to vomiting as produced by blows upon the head or epigastric region, or by irritating the fauces, or drinking warm water, or by undigested food, or as arising from irritations of the uterus or kidney, &c., and all considered in connexion with the morbific and curative effects upon internal organs of cold applied to the surface or as it increases the secretion of urine, and many other analogous things—and the demonstration supplied by all the analogies, which, in all the foregoing cases, inevitably turns upon direct and reflex action of the nervous system, applied to the interpretation, through the same rationale, of all the analogous effects which flow from the operation of all other morbific and remedial agents of a tangible nature; and ultimately employed in demonstrating the substantive existence and self-acting nature of the Soul and Instinctive Principle, p. 324, § 500 *c*; p. 327–328, § 500 *i–m*; p. 340–341, § 514 *k–m*; p. 522–524, § 827 *b–d*; p. 530, § 837 *b*; p. 534, § 844; p. 631–632, § 892½ *b*; p. 666–670, § 902 *b–m*; p. 703–705, § 940–945; p. 707, § 947; p. 709–710, § 951–952; p. 865–868, § 1067; p. 888–890, § 1077. Also, Generalization of Reflex Action, *Index II.*
their presence in the secretions supplies no ground for the doctrine of remedial action by absorption, p. 520, § 826 *b*; p. 523–524, § 827 *d*.
Oil, Castor,
its special action upon the liver as an alterative, and its great advantages, p. 555, § 872; p. 568–569, § 889 *m*; p. 834, § 1057 *l*; p. 853, § 1060.
as an adjuvant to Calomel and Blue Pill, one of the best, p. 834, § 1057 *l*; p. 839, § 1058 *a*; p. 845–846, § 1058 *m, n*; p. 847, § 1058 *q*; p. 848, § 1058 *t*; p. 853, § 1060.
as a remedy, in small and repeated doses,

Oil, Castor—*continued.*
for habitual constipation, p. 366, § 556 *b*; p. 555, § 872; p. 568, § 889 *m*; p. 834, § 1057 *l*. Also, ALTERATIVES, *Index II.*
best cathartic in scarlet fever, p. 843, § 1058 *h*.
should be exhibited in *carefully regulated* doses throughout the progress of many diseases, and at the advanced stages of all, and for its gradually alterative effect, p. 555, § 872; p. 568–569, § 889 *m*; p. 834, § 1057 *l*.
possesses a soporific virtue, p. 834–835, § 1057 *l*.
time for its administration compared with other cathartics, p. 570, § 889 *n*; p. 835, § 1057 *l*.
injected into the circulation, and why its effects in that case, or in other similar examples, prove nothing in behalf of the supposed operation of remedies by absorption, p. 529–530, § 837 *a*, *b*; p. 675–676, § 904 *b*; p. 677, § 904 *c*.
OIL, CROTON,
its operation, as a cathartic, when simply applied to the tongue, or introduced into the rectum, in the quantity of a drop, illustrates the principle of continuous sympathy (or, as the Author prefers, continuous *influence*, p. 322, § 498 *a*), the impression being propagated, as in leeching the anus or septum nasi, continuously along the mucous tract, being equivalent to the direct passage of a cathartic, or any other irritation, while, also, the impression thus produced upon the tissue establishes an alterative reflex action of the nervous system, modified according to the nature of the exciting cause, and which is the common result of continuous sympathy, p. 58, § 129 *f*; p 322–323, § 498 *a–g*; p. 343, § 516 *d*; p. 344–345, No. 6; p. 526, § 828 *d*. Also, *Medical and Physiological Commentaries*, vol. i., p. 494–513; p. 569–574—and the logical mind will readily perceive that this is analogous to the reflex actions that are generated by impressions made by Mental Emotions upon the mucous tissue of the stomach and intestine, when they give rise to vomiting and purging, and apply the whole to the interpretation of morbific and remedial agents upon parts beyond the seat of their direct effect to alterative influences of reflex nervous action, while, also, the coincidences in effects between the physical and mental causes will as readily lead to the conclusion that all the morbific and remedial effects of Mental Emotions are equally as those of the physical causes owing to the same
Oil, Croton—*continued.*
versatile nervous influence. See ODORS, FEAR, DISGUST, MENTAL EMOTIONS, *Index II.* Also, § 1088 *b-d*
for like reason, when cathartics fall rather short of developing the full reflex influence that is necessary to the cathartic effect, chewing a little Rhubarb will often speedily and effectually determine the result. See CATHARTICS, *Index II.*
the foregoing principle is exactly the same as when reflex actions are instituted and progressively increased in force by inflammation of any part when propagated continuously from an isolated point, p. 343, § 516 *d*; p. 526, § 828 *d*; p. 563–564, § 889 *a*.
OPIUM—continued from *Index I.*,
"it is very singular that a pill of opium, administered by the stomach at night, will be vomited up in the morning, *after having produced its narcotic effect*" —explained by the Author through its development, by simple contact with the stomach, of an alterative reflex nervous action—as is also the "*very minute quantity* which always produced in a Physician *a scarlet efflorescence over the whole surface of the body*"—the former having its close analogy in the constitutional results of the first contact of food with the stomach, and the latter in the eruptive affections consequent upon intestinal disorders, along with analogous examples supplied by Strychnia, Hydrocyanic Acid, Hyoscyamus, Atropia, and Tobacco—carried to the interpretation of the modus operandi of all morbific and remedial agents upon parts beyond the seat of their direct operation through alterative influences of reflex action of the nervous system, p. 672–674, § 904 *b*. Also, SEDATIVES, FOOD, SKIN (eruptions of), SUPPOSITORIES, NARCOTICS, NERVOUS SYSTEM, *Index II.*
conclusions from experimental applications of, made to the nervous centres, stomach, and skin, that its effects are produced in all the cases by alterative influence of direct or reflex action of the nervous system, and introduced for the purpose of applying the same philosophy to the modus operandi of all other remedial and morbific causes, whether physical or mental, and to show that the nervous influence necessarily undergoes modifications in its nature according to the nature of its exciting causes, p. 301–303, § 481; p. 306, Exp. 21; p. 309–310, § 484 *b*, Nos. 5, 6. Also, p. 107–109, § 227–230; p. 592–593, § 891½ *k*; p. 670–675, § 902 *l*–904 *b*.

Opium—*continued.*
experiments with, by VOLKMANN and others, showing the distinction between the trunks of nerves and their expanded extremities, and how the skin is rendered by narcotization and other causes a very sensitive source of convulsions, and introduced by Author to expound the modus operandi of blisters, setons, mercury, iodine, miasms, and other agents applied to the skin through alterative influences of reflex nervous action, p. 308–310, § 484–485; p 319, § 894 *d*; p. 338, § 514 *d*; p. 348, § 516 *d*, No. 13. Also, SKIN, COLD, SETON, COUNTER-IRRITANTS, &c., *Index II.*
in producing no astringency, but in restraining colliquative sweats, checking the secretions of the liver, kidneys, &c., illustrates the modus operandi of true ASTRINGENTS through alterative influence of reflex action of nervous system, p 422–423, § 658; p. 577, § 890 *o*; p. 592–593, § 891½ *k*. Also, SILVER, NITRATE OF, LEAD, ACETATE OF; SULPHURIC ACID, COLD, IPECACUANHA, ERGOT, *Index II.*; § 890 *b*.
overcomes spasms by developing a counteracting reflex nervous influence, p. 592–593, § 891½ *k*. Also, ANTISPASMODICS, COFFEE, COLD, SKIN, *Index II.*
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does not apply his experiments pathologically or therapeutically, but inclines to the chemical and physical doctrines, p. 295, § 476 *a*; p. 309–310, § 484 *a*, No. 5; p. 314, § 488; p. 317–318, § 493 *a–d*.
Philosophy, Experimental. Also, Philosophy, *Index I.*,
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Phlebitis,
employed to illustrate the pathology of venous congestion, p. 501–505, § 792–801; p. 507–509, § 806–811—and which concur together, by the coincidences in their phenomena, and the sameness of treatment, in showing that the alterative influence of reflex nervous action is alike modified in a peculiar manner by both affections, p. 507–508, § 806. Also, Venous Congestion, Venous Tissue, *Index I.*

Phthisis Pulmonalis,—(Also, *Index I.*
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colliquative sweats of, arrested by Acetate of Lead and Sulphuric Acid, through alterative influence of reflex action of the nervous system, and the analogy carried to the modus operandi of other Astringents, and of all other remedies, p. 530, § 837 *c*; p. 557, § 890 *o.* Also, Lead, Acetate of; Sulphuric Acid; Silver, Nitrate of; Astringents, Ipecacuanha, Cold, *Index II.*
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Physicians,
Organic Chemistry imputes to them a fanatical reliance upon it, p. 781, § 1029; p. 808, § 1034.

Physiologists, (See Chem. Phys.)
affirmed on high authority that "it is a doctrine generally accepted at the present day that the glandular organ exerts a *catalytic* action on the elements of the blood as it traverses the organ," p. 791, § 1032 *c*—but will this explain all the analogous millions of distinct organic products out of mainly four elements, yet intimately combined with twelve or fourteen more in the blood and sap of all Animals and Plants, and their ternary and quaternary combinations, and their endless variety in disease, and as the glandular products, particularly, are affected by the passions—considering, too, that Plants begin with the elements of matter! p. 23–26, § 37–48; p. 27–28, § 51–53 *b*; p. 221–227, § 409 *b*–411. Also, Mental Emotions, Fear, and other individual *Passions*, Milk, Bile, Urine, Weeping, Sweat; Water, Hot; Kidney, Skin, Uterus, Parturition, *Index II.*; Nervous Power, *Index I. and II.*; Sudorifics, *Index I.*

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Plasters,
mercurial, anodyne, iodine, &c., and *irritating*, operate upon deep-seated parts after the manner of Cantharides and Seton through uninterrupted influence of reflex action of the nervous system, modified according to the nature of the remedy, p. 66–67, § 148; p. 107–111, § 226–233¾; p. 339, § 514 *g, h*; p. 344–345, § 516 *d*, No. 6; p. 348, § 516 *d*, No. 13; p. 659, § 893 *q*; p. 661–663, § 894–896; p. 664–676, § 900–904 *b*; p. 679–681, § 905 *a*; p. 838, § 1057½. Also, Counter-Irritants, Tobacco, Alteratives, Sphincter Muscles, *Index II.*

"Plastic Power" and "Organic Force," employed in Organic Chemistry as convenient substitutes for the term Vital Principle, p. 784, § 1031. Also, Vital Principle, *Index I*; p. 398, § 626 *b*.

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its treatment, especially by Bloodletting and Tartarized Antimony, p. 602, § 892 *i*; p. 638–642, § 892$\frac{4}{5}$ *f–i*; p. 749, § 992 *d*; p. 750, § 995; p. 757–760, § 1005 *h–k*; p. 770, § 1017 *c*; p. 846, § 1058 *o*; p. 870, § 1068 *c*.
Bloodletting in, opposed by Louis, and other distinguished French savans, and the resulting mortality, p. 760, § 1005 *k*—and the contrast in the United States, *ibid.* Also, p. 872, P.S.
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may be attended with a good pulse and other deceptive symptoms, p. 447–448, § 688 *i*.
an example of the rapidity with which the alterative influence of reflex nervous action will change the condition of the blood in small abstractions, p. 710, § 952 *b*.
the system sustained under large abstractions of blood by a powerful exciting nervous influence developed by the inflammation, being reflex in pneumonia, and direct in cerebral inflammation, p. 733–734, § 974 *a*–975; p. 748–749, § 992 *b–d*. Also, Brain, Inflammation of, *Index II*.
"*typhoid*," examples of successful and adverse treatment, p. 757–759, § 1005 *h*; p. 760, § 1005 *k*. Also, p. 751–752, § 999 *c*.
"*bilious*," treatment by bloodletting in the Minorca epidemic, and its success contrasted with its neglect, p. 757–759, § 1005 *h, i*. Also, p. 872, P.S.

Portal Circulation,
proves the dependence of venous circulation upon the suction power of the heart, p. 211, § 390. Also, Circulation of the Blood, *Index II*.

Potash, Tartrate of,
in connexion with jalap, a valuable compound, p. 845, § 1058 *m*; p. 853, § 1060.

Potash and Soda, Tartrate of,
possesses advantages over other saline cathartics, p. 555, § 872 *a*; p. 853–854, § 1061.

Poultices, Hot, and Hot Fomentations, their importance in conservative surgery, p. 682–683, § 905 *b*.
relieve superficial inflammation by directly modifying irritability (p. 89, § 188), and remove any resulting disturbance of internal organs mostly through the simple subsidence of the stimulating reflex nervous influence to which the inflammation had given

Poultices, Hot, &c.—*continued.*
rise, and relieve the pain of superficial parts by diminishing sensibility in a direct manner (p. 100, § 198; p. 671, § 903), though doubtless, in part, in either case, through a sedative reflex nervous influence reverberated upon the part—and relieve primary diseases, pain, &c., of internal parts wholly through sedative influence of reflex action of the nervous system, p. 592–593, § 891½ *k*; p. 681–682, § 905 *b*; p. 838, § 1057½. Also, p. 66–67, § 148; p. 338, § 514 *d*; p. 351–352, § 524 *b–d*; p. 421–423, § 657–658; p. 483–484, § 746 *c*; Opium, Sedatives, Seton, *Index II*.

Predisposing Causes. See Causes, Morbific, *Index II*.

Predisposition to Disease—continued from *Index I.*,
when owing to present influences, consists of some inappreciable change in the organic properties, corresponding in a general sense with the special virtues of the morbific causes, and which may remain for a short or for a long time without manifesting any functional derangement, when, at last, it may have acquired such a degree of intensity as to explode suddenly in absolute disease, or may require exciting causes for its full development—though often before the irruption takes place there are many obscurely marked symptoms that denote its approach—while, also, the predisposition is always at first formed, when owing to external causes, in one of the surfaces with which they come in contact, and in which they may or may not produce disease, and from which it is propagated over other parts through alterative and uninterrupted influences of reflex action of the nervous system, p. 47–49, § 75–81; p. 65, § 143; p. 66–67, § 148; p. 426–427, § 666. Also, p. 107–112, § 227–234 *b*; p. 230, § 432; p. 245, § 440 *e*; p. 253, § 441 *d*; p. 323–324, § 499–500 *c*; p. 339–340, § 514 *g–k*; p. 344–345, § 516 *d*, No. 6; p. 348, § 518; p. 351–352, § 524 *c*; p. 359, § 527 *b*; p. 360, § 527 *d*; p. 368–369, § 559–562; p. 378–380, § 578 *c, d*; p. 385, § 591; p. 416–417, § 649 *c*; p. 420–427, § 654–666; p. 429–430, § 674 *d*; p. 481, § 743; p. 483–484, § 746 *c*; p. 490, § 760; p. 491–492, § 674 *a, b*; p. 497, § 777; p. 553, § 827 *c*; p. 661–663, § 894–896; p. 669–670, § 902 *i*; p. 670–671, § 902 *m*; p. 679–681, § 905 *a*; p. 880, § 1074. Also, Hydrophobia, Virus of; Skin, Cold, Sphincter Muscles, Seda-

Predisposition to Disease—*continued.*
tives (*Aconite*), Suppositories, Seton, Plasters; Causes, Morbific; Alteratives, *Index II.*
may be produced not only by external causes, but by a variety of internal, both physical and mental—the nervous influence, either direct or reflex, being equally instrumental in all the cases, p. 414–415, § 646–647; p. 423–424, § 659–660. Also, p. 55, § 117; p. 58–59, § 129; p. 65, § 143 *b*; p. 106–111, § 222–233¾; p. 332, § 501; p. 339–340, § 514 *h*; p. 465–466, § 715. Also, Mental Emotions, the individual *Passions*; Causes, Morbific, *Index II.*
should disease be set up in the part upon which morbific causes make their direct impression, it may be the direct effect of the agent, or more commonly the result of alterative influences of nervous action reflected upon the part either as a consequence of the primary impression or as instituted by some supervening disease in other parts—observing the same rule in this respect as remedial agents, p. 66–67, § 148; p. 333, § 502–506; p. 339–340, § 514 *h*; p. 347–348, § 516 *d*, No. 13; p. 351–352, § 524 *b–d*; p. 416–417, § 649 *c*; p. 421–424, § 657–660; p. 426, § 666; p. 429–430, § 674 *d*; p. 465, § 714; p. 483–484, § 746 *c*; p. 522–523, § 827 *b*, *c*; p. 539, § 848; p. 862–864, § 1066.
or is inherited—when the predisposing causes have operated upon ancestors, and this predisposition being equivalent to a knowledge of the predisposing causes is assumed as a predisposing cause, p. 424, § 661; p. 561, § 886.
may continue after disease has subsided, as seen in fever, dyspepsy, &c., when great prudence is apt to be necessary to avoid relapses, p. 425–426, § 665; p. 495, § 769; p. 598–604, § 892 *d–k*, and *ut supra*, and Habit, Vital; Fever, *Index II.*
a knowledge of its remote causes often very important for detecting the true nature of the pathological, and for directing the treatment, p. 361, § 529 *b*; p. 414, § 644; p. 423–425, § 659–662; p. 480, § 742; p. 487–488, § 756; p. 497, § 776; p. 509, § 811; p. 510, § 813 *a*, *b*; p. 545, § 859 *b*; p. 553, § 870 *aa*; p. 559–561, § 883 *b*–886; p. 589, § 891 *o*; p. 639–641, § 892⅘ *g–i*; p. 723, § 960 *h.*
has often but one efficient and indispensable remote cause, as in smallpox, measles, malignant cholera, fevers, &c., but there may be many

Predisposition to Disease—*continued.*
antecedent ones which predispose the system to be acted upon by the essential one, and render the disease more malign, often more prevalent, and modify the treatment—and while the miasmata upon which fevers depend have their action promoted and increased in intensity by a variety of subordinate causes that are incapable of producing the disease, the same miasmata are prolific in predisposing the system to the action of more specific causes, as the self-limited diseases, the malignant cholera, &c., and often lay the foundation of indigestion, or complicate rheumatism, pneumonia, puerperal fever, &c.—or the complicating influences may depend upon hereditary peculiarities, p. 65, § 143 *a–c*; p. 67, § 149–151; p. 418, § 652 *b*; p. 420, § 654 *a*; p. 424–425, § 662–663; p. 438–442, § 686; p. 489, § 756 *b*; p. 509, § 811; p. 510, § 814; p. 511, § 816 *d*; p. 538, § 848; p. 544–545, § 855; p. 553, § 870 *aa*; p. 597, § 892 *c*; p. 723–725, § 960 *b*–961; p. 756–757, § 1005 *b–j*. Also, Causes, Morbific, *Index II.*
Pregnancy,
illustrates the natural mutability of the properties of life, which, although designed for useful ends, is rendered, in the great plan of organic beings, the foundation of all the changes that arise from the operation of physical causes, morbific and remedial, and of the mental emotions, and derides all chemical hypotheses, p. 87, § 180; p. 352, § 524 *d*; p. 378, § 578 *c*; p. 434–435, § 680; p. 471, § 732 *d.* Also, Youth, Infancy, Uterus, Organs of Generation, Lactation, Milk, Parturition, *Index II.*; Vital Properties, *Index I.*
occasions an endless amount of reflex nervous influences from those which are at work upon the stomach from the outset, and with various intensities and intermissions, to those which are in perpetual progress in gradually unfolding the mammæ till their force and rapidity of action upon those organs become suddenly increased at the crisis of parturition—and which supply a ready interpretation of the modus operandi of all morbific and remedial agents, and according to the nature of each one, through the same alterative influences of reflex action of the nervous system, and whether those influences be suddenly exerted as in the case of cathartics and emetics, or continuously as with setons

Pregnancy—*continued.*
and frequently repeated doses of medicines, p. 56, § 120, 121; p. 61, § 133 *c*; p. 87, § 177; p. 111, § 233¾; p. 117–120, § 234 *g*–235; p. 231–232, § 424; p. 330, § 500 *nn*; p. 335–336, § 512 *a*, *b*; p. 352, § 524 *d*; p. 662–663, § 896; p. 686, § 905½ *b*. Also, Uterus, Organs of Generation, Lactation, Parturition, Milk, Kidney, Mental Emotions, Love, Jealousy, Fear, Reflex Action, Cathartics, Emetics, Respiration, Sphincter Muscles, Alteratives; Antimony, Tartarized, *Index II.*; Nervous Power, Youth, *Index I. and II.*

Prescriptions,
should be extemporaneous, and all formulæ of, with definite proportions of the constituents, empirical and regardless of pathological conditions, p. 67–68, § 150–152; p. 543–544, § 857; p. 545, § 859 *b*; p. 554–556, § 872 *a*. Also, Pathological Cause, Remedies, *Index II.*

Primordial Cell. See Cell, Primordial, *Index II.* Also, Ovum.

Pritchard,
"gets rid of the mystery of Vitality," and Carpenter also, p. 40, § 94 *h*.

Protein—continued from *Index I.*,
not in the blood, p. 784, § 1031 *b*.
conceded that "the term is destined to indicate a past epoch in Organic Chemistry," p. 781, § 1029.

Prout,
his opinion upon chymification, p. 152–153, § 345–347.

Proximate Cause. See Pathological Cause, *Index II.*

Proximate Principles—continued from *Index I.*,
are artificial transformations, p. 781, § 1030; p. 791, § 1032 *c*.

Puerperal Fever. See Fever, Puerperal, *Index II.*

Pulse,
considered in its only important symptoms—*hardness*, *softness*, *incompressibility*, *compressibility*, *quickness*, *slowness*, *frequency*, *fulness*, *smallness*, *strength*, *weakness*, *obstruction*, *freedom*, *intermission*, *redoubling*, *trembling*, and other *inequalities*, p. 443–448, § 687½, 688.
hardness and *incompressibility* characteristic of inflammation, and the most important and reliable symptoms as denoting the nature and force of the disease—owing to the propagation of an alterative reflex nervous influence upon the arteries, and through which influence the blood, also, is so changed in its condition as to result in buffing and cupping after its abstraction,

Pulse—*continued.*
while, again, the nervous influence may be immediately so altered in its influence by loss of blood, or a mental emotion, or more gradually by other causes, as to dissipate those symptoms—thus showing, also, how the nervous influence is variously modified by disease, and how remedies of a heterogeneous nature will effect modifications that will bring about a common result, and how the mental emotions are on the same ground of causation as physical agents, p. 66–67, § 148–151; p. 310, § 485; p. 313, § 487 *gg*; p. 444–445, § 688 *a*–*f*; p. 547–550, § 863 *d*; p. 552, § 868 *b*; p. 664–665, § 900, 901; p. 703–710, § 940–952 *b*; p. 731–732, § 970 *c*. Also, § 811; § 826 *cc*. Mental Emotions, Remedies, Soul and Instinct, *Ind. II.*; Nervous Power, *Index I. and II.*
frequency of, the next most important condition, p. 446–447, § 688 *i*.
nevertheless, affections of the brain and heart may bestow more unequivocal signs, p. 212, § 390 *b*; p. 313, § 487 *gg*; p. 443, § 687½; p. 447, 448, § 688 *i*–*l*.
intermission of, and other *irregularities*, are mostly dependent upon hepatic disorders, when not owing to affections of the heart and brain, and are not often important in the former case, p. 211–212, § 390 *b*; p. 447–448, § 688 *i*–*l*.
is so capriciously influenced by all mental emotions, posture, motion, remedies, food, and particularly by the reflected influences of the nervous system as developed by diseases, that it cannot be often trusted without the support of other symptoms, unless as it respects *hardness* and *incompressibility*, p. 443–448, § 687½–688; p. 511–512, § 815–817; p. 704–705, § 943 *a*, *b*; p. 712, § 955 *b*; p. 714, § 958 *b*; p. 723, § 960 *h*; p. 725–726, § 961 *b*, *c*; p. 727, § 962–964; p. 756–760, § 1005 *a*–*k*; Note Ll p. 1140.
to be regarded, therefore, merely as supplying certain symptoms through which the force and modifications of the nervous influence, either direct or reflex, as arising from all diseases, excepting of the heart, are more or less ascertained, and thus through its various influences upon the sanguiferous organs the nature and force of disease is inferred, in part, by the sense of touch—with the understanding that the capillary bloodvessels are the main instruments of disease upon which both direct and reflex action of the nervous system is determined with

Pulse—*continued.*
the alterative effects that arise from morbific and remedial causes, both physical and mental, p. 226–227, § 410, 411; p. 301–310, § 480–485; p. 354–355, § 526 *a, b*; p. 443–448, § 687½–688; p. 804–805, § 1040. Also, Heart, Tongue, Sweat, Urine; Brain, Inflammation of; Mental Emotions, *Index II.*; Nervous Power, *Index I. II.* Also, § 500 *m*, 694¾, 826 *cc*, 829.
method of feeling the pulse, § 687½, 688 *a*, 805, 812, 961, 971, 990 *g*.
Purpura Hemorrhagica,
its pathology, and treatment by bloodletting, p. 754, § 1002 *d–f*.
Pus,
a new formation, the result of a secretory process brought about by inflammation, and which constitutes a natural termination of the formative stage of that disease, p. 471, § 730.
liable to be affected in its condition by causes acting locally, but more generally through alterative influences of reflex action of the nervous system originating in some internal disease, or by the same influences propagated in a direct manner upon the instruments of its formation by Mental Emotions, p. 478–480, § 740–741. Also, Inflammation, Secretion and Excretion, Milk, Bile, Reflex Action, Mental Emotions, Sympathy, *Index II.*; Nervous Power, *Index I. and II.*; Vital Properties, Sudorifics, *Index I.*
allied, in principle, to lymph, mucus, and serum, when the latter are products of inflammation — each being consequences of the formative stage, p. 471–472, § 732 *b*–733, and *references* there; p. 474–475, § 733 *f–h*— all of which are designed for useful ends, but lymph and pus most so, p. 471–476, § 732–733; p. 546–547, § 862–863; p. 550–551, § 863 *e*–864.
all its varieties, like those of mucus, depend upon precise pathological conditions, and more or less upon the natural constitution of the part—which may be presented to Organic Chemistry as a problem for its solution, taking along the Mental Emotions as among the causes which modify the pathological states, p. 120–121, § 237; p. 452, § 693; p. 478–480, § 739–741 *b*. Also, p. 61–62, § 133–136; p. 67, § 149–151; p. 224, § 409 *h*; p. 226, § 410; p. 436, § 682 *b*, 409 *d*.

R.

Race, Human, Unity of—continued from *Index I.*,
briefly considered, p. 906–907, § 1078 *s*.
Recuperation, Law of,
so designated by the Author in preference to *Vis Medicatrix Naturæ*—ingrafted upon the constitution of all organic beings, and upon which the Art of Medicine reposes, and without which the whole animal kingdom would perish. See Vis Medicatrix Naturæ, Vital Properties, Organic Life; Adaptation, Law of, *Index I.*; Remedies; Causes, Morbific; Diseases, Self-limited, *Index II.*
instability of the properties of life, ordained for useful purposes, and their inherent tendency to maintain themselves in their normal state, lie at the foundation of Therapeutics, and the former, especially, of disease—morbific causes altering them in one way, and remedies in another less profoundly morbid, by which the law of recuperation is brought into effect, and this mutability is the source of natural changes which the system undergoes either in function or development of structure, as manifested in gestation, lactation, &c., and in the transition stages from infancy to adult age, in metamorphosis, &c., and is displayed in its morbific aspect by the impregnated ovum, p. 44–49, § 67–80; p. 61, § 133 *c*; p. 68–69, § 152–156; p. 83, § 174; p. 87, § 177–182; p. 88, § 184 *b*; p. 95–96, § 189 *b*; p. 98, § 191 *a, b*; p. 108, § 228 *a*; p. 109–110, § 230–232; p. 120–122, § 237–240; p. 131–132, § 285; p. 352, § 524 *d*; p. 373–383, § 576–584; p. 514, § 642 *b*; p. 538–540, § 847 *g*–848; p. 541, § 853; p. 542–543, § 854 *c*–856; p. 551, § 863 *h*; p. 558–559, § 879–883 *b*; p. 600, § 892 *d*; p. 664–665, § 899–901; p. 736, § 980; p. 902, § 1078 *p*; p. 435, § 680. Uterus, Organs of Generation, Parturition, *Index II.*; Vital Properties, Vis Medicatrix Naturæ; Adaptation, Law of, *Index I.*; Youth, *Index I. and II.*
Reflex Action of the Nervous System and Direct Action,
the term *direct*, and its distinction from *reflex* (the latter of which the Author sometimes designates as *indirect*, and oftener *Sympathy*), introduced as the basis of his interpretation of the modus operandi of the Will and Mental Emotions, and of the nervous influence as excited by affections of the nervous centres, and for expounding, along with reflex action, the modus operandi of Loss of Blood, and for demonstrating the substantive existence and self-acting nature of the Soul and Instinctive Principle—and, as farther explain-

Reflex Action, &c.—*continued.*
ed, the Author means by the term *direct* that the excito-motory nerves or fibres of compound nerves are alone engaged, unless the Passions, as is common, and diseases of the nervous centres, &c., institute impressions upon distant parts that are reverberated through centripetal nerves upon those centres, when the nervous influence may thus establish complex circles of reflex actions, and undergo modifications of its alterative influence according to the nature of the mental emotion or any affection of the nervous centres, as, also, according to that of the particular natural constitution of different parts, and any present modified condition of parts upon which it may fall, since, also, any preternatural condition of an organ, whether rendered temporarily so by disease, or only disturbed by the nervous influence (as in sneezing from a strong light impinging upon the retina, p. 327, § 500 *i*; p. 333, § 504; p. 340–341, § 514 *l*), is equivalent to influences propagated in like manner by the action of remedial and morbific agents, and will modify the nervous influence in a corresponding manner; and upon this reflected influence and its modifications depend the diseases of organs that grow out of each other, and the nature of the affections as they may spring up consecutively, and in connexion with the constitutional nature of different parts, or as they may conspire together in aggravating or relieving the conditions of each other—subject always to variations from age, sex, habits, &c., and although the nervous influence as propagated upon the voluntary muscles always terminates in the simple production of voluntary motion so long as the Will continues to operate, there is the remarkable exception of roosting, and some examples of man sleeping in an erect posture, in which it establishes an unceasing reflex action, and occasional instances of vomiting in which the Will is a concurring cause with some mechanical irritation of the stomach, p. 59, § 129 *h*, *i*; p. 61–68, § 133–152; p. 73, § 163; p. 101–102, § 201–202; p. 107–119, § 227–234; p. 282–284, § 451–453; p. 285–286, § 455; p. 296, § 476 *c*; p. 321, § 496, 497; p. 323–328, § 499–500 *l*; p. 331–334, § 500 *o*–510; p. 347–348, § 516 *d*, No. 13, 517; p. 429–430, § 674 *d*; p. 526, § 828 *d*; p. 539, § 848; p. 592, § 891½ *k*; p. 646–648, § 893 *e*–*g*; p. 661–663, § 894–896; p. 665–676, § 902 *a*–904 *b*; p. 679–681, § 905 *a*; p. 692, § 914–921; p. 698–699, § 930–935; p. 703–710, § 940–952; p. 745–746, § 990½; p. 831–833, § 1057 *f*–*h*; p. 838, § 1057½; p. 865–868, § 1067; p. 874–881, § 1071–1075; p. 886–891, § 1077. Also, Will, Nervous Power, Sympathy, *Index I. and II.*; Mental Emotions; Brain, Inflammation of; Roosting, *Index II.*

Reflex Action, &c.—*continued.*
rejecting entirely the exceedingly simple doctrine of Chemistry as to the agency of the nervous system in the various processes and products of the animal kingdom, and which have no reference to the physiological laws of that system, but consisting alone in an abstract idea, the Author maintains in all his principal writings, as the groundwork of their philosophy, that the nervous system is endowed with a property, power, or influence (no matter which) that operates as a vital agent, and is so far on common ground with other vital agents, and that it is susceptible of an endless variety of modifications according to the nature of the causes by which it is brought into action, and that there is imparted to it the essential virtues of the various causes respectively, both physical and mental, and that when morbific and remedial agents bring about changes in the natural condition of the solids and fluids, in parts beyond the seat of their direct action, or whenever analogous effects are exerted by the Mental Emotions, or when diseases ensue upon each other, or when one disease becomes the cause of relief to another, whether natural or artificial, it is always by *alterative* influences of direct or reflex action of the nervous system determined upon the capillary vessels, or main instruments of all organic functions, and that these influences depend not only on the nature of the exciting causes and other accidental circumstances, but also more or less upon the special vital constitution of different tissues and different parts of a continuous tissue—and whether, therefore, the Chemical Philosopher have any vague regard to the nervous system, or ascribe, as he mostly does, all the results of physical agents to their absorption and direct chemical action, and leaves the "action of the nerves" and mental phenomena obscured by "a veil which is not to be raised" (p. 183, § 350¾ *gg*), the difference between him and the Author consists in the violation by the former of all the facts and analogies supplied

Reflex Action, &c.—*continued.*
by that inorganic world from which he professes to derive his conclusions, and the absolute inapplicability of any one of the doctrines to practical medicine, while the Author presents, as he believes, a perfectly consistent array of an endless series of facts and of practical doctrines which are incontrovertible in every detail, and which has the special merit of bringing the Author's doctrine of the operation of the *Mental Emotions* and the *Will* through the medium of the nervous influence into perfect harmony with that of all physical causes, p. 59, § 127 *i*; p. 65, § 143 *b*, *c*; p. 67–68, § 149–152; p. 89, § 188; p. 101–102, § 201–202; p. 106–111, § 222–233¾; p. 230–233, § 422–427; p. 282–284, § 451–453; p. 285, § 455 *b*, *f*; p. 295–296, § 476 *b*, *c*; p. 301–304, § 480–481; p. 305, § 481 *h*; p. 307–308, § 483 *c*; p. 310, § 484, Nos. 5, 6; p. 313, § 487 *h*; p. 314, § 488½; p. 321, § 496, 497; p. 323–328, § 499 *b*–500 *m*; p. 333–341, § 503–514; p. 344–345, § 516 *d*, No. 6; p. 347–349, § 516 *d*, No. 12–520; p. 351–353, § 524; p. 356–358, § 526 *d*; p. 360–362, § 528, 529 *b*, 530; p. 421–423, § 657 *a*–660; p. 426, § 666 *a*; p. 465–467, § 714–719; p. 506, § 803, 804; p. 520–521, § 826 *d*; p. 523, § 827, *b*, *c*; p. 538, § 847 *g*; p. 549, § 898; p. 565, § 889 *f*, *g*; p. 592–593, § 891½ *k*; p. 619, § 892½ *t*; p. 631–632, § 892¾; p. 634, § 892⅘ *b*; p. 640, § 892⅘ *h*; p. 644–650, § 893 *c*–*i*; p. 652–656, § 893 *n*; p. 661–672, § 894–904; p. 679–681, § 905 *a*; p. 703–711, § 940–952; p. 732–736, § 971–980; p. 745–746, § 990½; p. 803, § 1039; p. 862–868, § 1066–1067; p. 875–877, § 1072 *a*; p. 879–880, § 1074; p. 887–890, § 1077; p. 930–932, § 1088 *a*–*d*.
a still more remarkable attribute of the nervous influence than the modifications to which it is liable, and perfectly demonstrable, is a perpetual election, throughout the organism, of particular excito-motory nerves without any apparent reference to their order of arrangement, manifesting its effects between parts remote from each other, and remote from the nervous centres, and neglecting all intermediate parts, and equally so whether the natural stimuli of life, or Mental Emotions, or the Will be the exciting cause; and since this is also equally true of remedial and morbific agents, and could not be so were their operation through the medium of the circulation, the Author derives from

Reflex Action, &c.—*continued.*
these exact coincidences between the natural, remedial, and morbific agents an irresistible proof that the latter exert their effects equally with the former through the medium of reflex action of the nervous system (or originally direct in the case of Mental Emotions), and which renders the chemical, galvanic, electrical, and other physical hypotheses simply ridiculous, p. 75–79, § 166–167 *f*; p. 112, § 234 *a*; p. 111, § 233¾; p. 116, § 234 *f*; p. 326–328, § 500 *g*–*m*; p. 330, § 500 *nn*; p. 666–672, § 902 *b*–904 *b*. Also, p. 174–183, § 350½–350¾ *gg*.
various explanations relative to the mechanism through which the nervous influence operates in its function of reflex action, for the purpose of applying it to the interpretation of the modus operandi of all remedial and morbific agents upon parts beyond the seat of their direct operation, and also of its limitation in other cases to the motor nerves, or as direct impressions when thus produced may give rise to reflex actions, and as the cause of all the physiological changes in the solids and of all increased or otherwise modified changes in the fluids, through its various influences upon the instruments of organic processes, and of its modifications according to the nature of its exciting causes, as well, also, for proving the substantive existence and self-acting nature of the Soul and Principle of Instinct, p. 101–102, § 201–202; p. 108, § 227, No. 2; p. 112, § 234 *b*; p. 116–117, § 234 *f*; p. 282, § 451 *d*; p. 285–287, § 455 *d*–459 *a*; p. 290–296, § 462–476½; p. 300, § 479; p. 309–310, § 484 *b*, Nos. 5 and 6; p. 312–315, § 487 *g*–489; p. 321, § 496, 497; p. 323–328, § 499 *a*–500 *m*; p. 331–341, § 500 *c*–514 *n*; p. 344–345, § 516 *d*, No. 6; p. 347–349, § 516 *d*, No. 13–520; p. 416–417, § 649 *c*; 421–423, 657–658; p. 465–466, § 715; p. 484, § 746 *c*; p. 523, § 827 *c*; p. 565–566, § 889 *f*, *g*; p. 592–593, § 891½ *g*, *k*; p. 642–647, § 893 *a*–*e*; p. 661–663, § 894–896; p. 665–670, § 902 *a*–*n*; p. 679–681, § 905 *a*; p. 703–710, § 940–952; p. 733–734, § 974 *c*–975 *b*; p. 873–881, § 1069–1075; p. 886–891, § 1077. Also, Nervous Power, *Index I. and II.*
its essential principle, the nervous power, or whatever it be, is not a movable substance, *in transitu* from part to part, but, like the principle of Light, is every where diffused through its appropriate medium, and, like that principle, is brought into operation by

Reflex Action, &c.—*continued.*
exciting causes, and with every variety of effect, according to the nature of the causes; nor is there any greater difficulty in understanding its imputed modifications than the polarization of light, or any other attributes which the Author assigns to them, than such as appertain to Light, p. 80, § 169 *b, d;* p. 84, § 175 *b, bb;* p. 88, § 184 *b;* p. 110, § 232; p. 114–120, § 234 *e*–235; p. 330, § 500 *nn*; p. 334, § 507; p. 670, § 902 *k.*
its application to the modus operandi of all remedial and morbific causes is founded upon natural laws; and the Author maintains that, if there be any thing in the consistency of Nature, or any thing in facts, the same physiological laws which govern the organization of the animal kingdom in its normal state are equally at the foundation of all its deviations from the natural standard, and that this universal principle embraces completely the physiological laws of the nervous system, which, indeed, the Author has demonstrated by a multitude of exact coincidences between the results of natural causes and those of a morbific and remedial nature, both physical and mental, as appears in a summary manner in the following sections, and in great amplification under the topics embraced in the Article *Generalization of Reflex Action, Index II.*, p. 1–2, § 1 *a;* p. 3–4, § 2 *b–d;* p. 106–112, § 222–234 *b;* p. 282–295, § 451–475; p. 321–362, § 495–530; p. 405–412, § 638; p. 413, § 639–640; p. 541–543, § 852 *a*–857; p. 661–678, § 894–904; p. 679–681, § 905 *a;* p. 692–693, § 915–921; p. 698–699, § 929–935; p. 703–711, § 940–952. Also, Soul and Instinctive Principle, *Ind. II.*—§ 718, 795, 892 *b*, 990½ *a, b.*
the entire dependence of respiration upon reflex action of the nervous system, as the stimulus of the muscular mechanism, coincides with the dependence of the act of vomiting upon the same causation, and carried by the Author through a long chain of analogies consisting of the various modifications of respiration, of vomiting as produced by emetics of various kinds, by loss of blood, by tickling the fauces, by tobacco applied to the soles of the feet, by pregnancy, by shock of falls, &c., and by Mental Emotions, and the divers influences and results according to the nature of the cause, and other coincidences supplied by the iris, sphincter muscles, heart, cold, suppositories, tetanus, &c., which depend upon other institutions of the nervous influence through centripetal and centrifugal nerves, and the analogies supplied by the Will in voluntary motion—all carried to the interpretation of all the effects of active emetics and cathartics, both remedial and morbific, and, by the same analogies, their effects when they fall short of vomiting and purging, or other prominent results that arise from larger doses, through *alterative* influence of reflex action of the nervous system, and against the chemical and physical doctrines of operation through absorption—and all this chain of analogies applied to the modus operandi of all other remedial and morbific causes, physical and mental, while the same interpretation of all the others is sustained by other special demonstrations in immediate connection with a large number of the several things respectively, p. 66–67, § 148; p. 110, § 232; p. 323–341, § 499–514 *m;* p. 334–335, § 516 *d*, No. 6; p. 347–348, § 516 *d*, No. 13; p. 421–423, § 657–658; p. 526, § 828 *a;* p. 532–533, § 841; p. 542–543, § 854 *c–f;* p. 547–550, § 863 *d;* p. 563–566, § 889 *a–g;* p. 568–569, § 889 *m, mm;* p. 592–593, § 891½ *k;* p. 631–632, § 892¾ *b;* p. 661–663, § 894–896; p. 666–678, § 902 *b*–904 *d;* p. 679–681, § 905 *a;* p. 703–710, § 940–952; p. 831–833, § 1057 *f–g;* p. 838, § 1057½. Also, Stomach, Nauseants, Disgust, Emetics, Mental Emotions, Tetanus, Remedies; Causes, Morbific; and Generalization of Reflex Action, *Index II.*—Notes D p. 1114, Cc p. 1132.
in the natural state of the body, although in constant operation among all parts, is not strongly manifested excepting in particular functions, as in respiration, motions of the heart and intestinal canal, motions of the iris, &c., or unless brought into action by special causes, as when it starts the urine as excited by cold, or the milk at the time of parturition, and by the Mental Emotions when its displays are very strongly pronounced, the influence being then primarily developed in a direct manner, and by the Will, when it is always direct, but exactly equivalent to reflex action, p. 54–55, § 111–117; p. 230–232, § 422 *b*–424; p. 284–289, § 454–461; p. 296, § 476 *c;* p. 323–335, § 499–512; p. 355, § 526 *a.* Also, Remedies; Causes, Morbific; Remedial Action, Mental Emotions, the individual *Pas-*

Reflex Action, &c.—*continued.*
sions, Disgust; Brain, Inflammation of; Secretion and Excretion, Urine, Sweat, Skin, Cold, Milk, Bile, Food, Roosting, Respiration, Sphincter Muscles, Youth, Uterus, Organs of Generation, &c., *Index II.*
is the exciting cause (primarily direct or centrifugal in affections of the nervous centres) of all diseases which ensue as consequences of each other, but the secondary affections may be very different from the primary, depending, in part, upon the peculiar constitution of different tissues or of parts of a tissue, p. 61, § 153 *a*, *b*; p. 62–68, § 135–152; p. 109, § 229; p. 339–340, § 514 *h*; p. 355, § 426 *a*; p. 450, § 689 *l*; p. 465–469, § 715–722; p. 731, § 970 *c*; p. 483–484, § 746 *c*. Also, Causes, Morbific; Inflammation; Brain, Inflammation of; Skin, Tobacco, Seton, *Index II.*; Nervous Power, Sympathy, *Index I. and II.*
through its influences upon the organic properties, is the cause of all increase or diminution of the secretions, and of all other changes that may befall them, when not the immediate consequence of the direct local operation of other causes, as in vesication, and of many of the changes which the blood undergoes, and whenever affected by Mental Emotions, though in the latter case the primary development of the nervous influence is directly centrifugal, and in all these cases through an exciting, or depressing, or other modifying effects upon the instruments of the organic processes, p. 230–232, § 422 *b*–424; p. 289, § 461; p. 296, § 476 *c*; p. 310, § 485; p. 331, § 500 *o*; p. 332–334, § 501–507; p. 335–336, § 512 *a*–513; p. 421–423, § 657–658; p. 483–484, § 746 *c*; p. 592–593, § 891½ *k*; p. 631–632, § 892¾; p. 666–669, § 902 *b*–*h*; p. 704, § 943 *a*, *b*; p. 710, § 952 *b*–*h*; p. 353, No. 7. Secretion and Excretion, Urine, Milk, Bile, Weeping, Sweat, Food, Fear; Water, Hot; Antimony, Tartarized; Bloodletting, Mental Emotions, *Index II.*; Sudorifics, *Index I.*
examples of its effects in subduing violent inflammations, and of variously and suddenly modifying the condition of morbid fluid products and the condition of the blood, when brought into operation primarily in a direct manner by Mental Emotions, p. 296, § 476 *c*; p. 230–232, § 422 *b*–424; p. 335–336, § 512 *a*, *d*; p. 355, § 526 *a*;
Reflex Action, &c.—*continued.*
p. 630–632, § 892¾ *b*; p. 709–710, § 951 *b*–952; p. 865–868, § 1067.
explains the philosophy of *metastasis* and *revulsion*, which is applied analogically to the modus operandi of morbific and remedial agents through the reflex action of the nervous system. See Metastasis, *Index II.*
the cause of all violent disturbances and convulsions, a large proportion of which depend upon simple irritations of comparatively unimportant parts, and supply a fertile analogy for the Author's interpretation of the modus operandi of morbific and remedial causes, physical and mental, through direct and reflex action of the nervous system, p. 357–358, § 526 *d*; p. 467–468, § 719; p. 590–591, § 891½ *b*; p. 592–593, § 891½ *k*. Also, Convulsions, Hysteria, Spasmodic Affections, Tetanus, Antispasmodics, Opium, *Index II.*—Note D p. 1114.
influences the production of animal heat, which the Author endeavors to show is a secreted product, and upon common ground with other secretions, p. 267–270, § 446–447; p. 807–808, § 1044–1045. Also, p. 68, § 152 *a*; p. 245, § 440 *e*; p. 250–251, § 441 *c*; p. 335–336, § 512 *a*, *b*; p. 339, § 514 *h*; p. 365, § 889 *g*; p. 579–580, § 890½ *d*. Organic Heat, *Index I.*; Hybernating Animals, Tea, *Index II.*
extensively applied in refutation of the chemical hypothesis of animal heat, p. 240, § 440 *b*; p. 250–253, § 441 *c*, *d*; p. 255–256, § 441½ *a*; p. 262–270, § 446 *a*–447 *d*; p. 335–336, § 512, 1044 *a*, Note T p. 1125.
the Author's doctrine of its being the immediate and universal exciting cause of all the effects of morbific and remedial agents beyond the seat of their direct operation, through its influences upon the instruments of organic processes, and the philosophy which concerns the substitution of transitory pathological conditions for the more profound, illustrated by the modus operandi of a *Seton*, p. 679–681, § 905 *a*.
is always the cause of disease that may supervene in parts which are the direct seat of the operation of miasmata, or as it may spring up in the skin when ordinary degrees of cold give rise to pneumonia, &c., through the same reflex action, and in many analogous cases, and is generally a concurring cause in the production and cure of diseases in parts upon which all morbific and remedial agents exert

Reflex Action, &c.—*continued.*
their direct effects, and in all cases the influence thus reflected may be simply a reverberation through the centrifugal nerves of the parts immediately acted upon, or the reflex influence may depend upon impressions transmitted from the superficial to internal parts, whether morbific or curative—exceptions to which may appear to occur in Setons, Counter-Irritants, &c., but in these cases reflected action upon the injured part is sooner or later brought into operation, p. 66–67, § 148; p. 284–287, § 454 *c*–459; p. 289, § 461; p. 315–316, § 492; p. 336–340, § 514 *b, g, h*; p. 351–353, § 524 *d*; p. 416–417, § 649 *c*; p. 421–423, § 657–658; p. 483–484, § 746 *c*; p. 522–523, § 827 *b, c*; p. 531, § 840. Also, Miasm, Predisposition, Skin, Cold, &c., *Index II.*
considered in its slowly progressive operation when brought into effect by Author's group of Alteratives, and analogous means both physical and mental—the same being also true of the slowly progressive operation of morbific causes, p. 111, § 233½, 233¾; p. 285–286, § 455 *d–f*; p. 333, § 503–506; p. 339, § 514 *g*; p. 344–345, § 516 *d*, No. 6; p. 365, § 551; p. 366, § 556; p. 416–417, § 649 *c*; p. 420–424, § 654–661; p. 532, § 841; p. 547, § 863 *d*; p. 551, § 877; p. 568–569, § 889 *m, mm*; p. 592–593, § 891½ *k*; p 599–600, § 892 *d*; p. 646–649, § 893 *e–h*; p. 661–663, § 894–896; p 668–670, § 902 *g–m*; p. 675–676, § 904 *b*; p. 679–681, § 905 *a*. Also, Hydrophobia, Virus of; Predisposition, Miasm, Small-pox, Alteratives, Sphincter Muscles, *Index II.*
applied in expounding the modus operandi of Cinchona, Loss of Blood, and of other things of which we are said to be ignorant, and in connexion with illustrations drawn from the modus operandi of a Seton, and where, also, under the several references, the organic influences of remedial agents through the instrumentality of nervous action, and the philosophy which concerns their substitution of transitory pathological conditions for the more profound as the fundamental cause of cure, is summarily presented, p. 596–597, § 892 *b, c*; p. 676–681, § 904 *b*–905 *a*. Also, p. 67, § 149–151; p. 73, § 163; p. 108–110, § 227–232; p. 542, § 854 *c–e*; p. 554, § 871; p. 592–593, § 891½ *k*; p. 661–663, § 894–896; p. 664–665, § 900–901. Also, Bloodletting, Remedies, &c., *Index II.*

Reflex Action, &c.—*continued.*
but it is not alone the foregoing analogies, as supplied by respiration, vomiting, &c., and a multitude of others of a corresponding nature, that are tributary to the Author's doctrine of the modus operandi of remedial and morbific agents, through reflex or direct action of the nervous system, but an almost universal proof to the same effect is supplied by all the muscular movements in organic life, by that of the muscular coat of the intestinal canal, by the muscles of deglutition, that of the bladder, that of the uterus, &c., and, what is especially important, by the heart and entire arterial and venous systems, whose active motions, if not wholly determined as it respects their exciting cause, are at least greatly influenced by the reflex action of the nervous system excited by the stimulus of blood, being wholly true of the heart, p. 301–310, § 481–485; p. 338–339, 514 *f*; p. 343, 344–348, § 516 *d*, Nos. 3-5, 7, 12, 13, and conspicuously so by mental emotions, food, exercise, &c., and by diseases generally, all of which is referable alone to the stimulus of nervous influence—upon which, collectively, is founded, in part, the Author's doctrine of the action of the capillary arteries and of the veins as among the important elements in the circulation of the blood, p. 62, § 136; p. 209–210, § 384–387; p. 211, § 390 *b*, and deduced, in farther part, from experiments made upon arteries by Buniva, Procter, and Kreimer, p. 215–216, § 399; p. 310, § 485, and subsequently confirmed by Brown-Séquard and others, p. 803–804, § 1039; p. 805, § 1041—and which is at the foundation, in part, of the Author's theory of the active condition of the instruments of inflammation, p. 485–486, § 750–751, and *references* there, and of his theory, also, of the ready transition of venous congestion into the ordinary form of inflammation, p. 506–507, § 803, 804—and in consideration of all of which, and of the manifest influences of the nervous system upon the capillary bloodvessels (those main instruments of all organic processes and their results, p. 226–227, § 410, 411) that are determined upon them by a vast variety of the natural stimuli of life, physical and mental, it cannot be doubted that all remedial and morbific agents must of necessity exert, through that same nervous influence, more powerful and disturbing effects upon those instruments, and thus become

Reflex Action, &c.—*continued.*
the immediate exciting cause of disease, of the increase, diminution, and other changes in the secretions, and equally also of those pathological variations impressed by remedial agents, and through which the more profoundly morbid are placed in the way of the recuperative process, p. 541–542, § 852–854 *e*; p. 664–665, § 899–901. Also, Skin, Cold, Kidney, Organs of Generation, Uterus, Parturition, Food, Fear, Disgust, Nervous System, &c., *Index II.*; Vital Properties, Organic Life, *Index I.*; Nervous Power, *Index I. and II.*
but the nervous influence is in no fundamental sense, as is generally supposed, the cause of the organic functions in Animals any more than of the analogous functions of Plants, which are carried on by properties implanted in all parts, but contributes a modifying and exciting or depressing influence to the nutritive and other secretory vessels, through which the products are perfected, or increased, or diminished; but these instruments are constantly liable to preternatural influences from either direct or reflex nervous action, and of an endless variety, and there is no function in the natural state of the body, no condition of disease, no action of remedies, in which the nervous system does not participate (p. 54–55, § 109 *b*–117; p. 284–287, § 454 *c*–459; p. 289, § 461; p. 483–484, § 746 *c*), while organs in their compounded condition are more evidently under its perpetually harmonizing influence through the impressions made upon their minute structure—and coming to many functions that are less concerned, or not at all, in the essential processes of organic life, as in respiration, contraction of the sphincter muscles, motion of the iris, peristaltic movements, &c., the nervous influence is the only immediate exciting cause—an obvious distinction, therefore, being made by the Author between the nervous influence as an *exciting* or *modifying* cause or *vital agent* and the fundamental causes or organic properties by which, in connexion with organization, the functions are carried on; and hence, whenever the Author speaks of the nervous influence as a *cause*, he simply means an *exciting* or *modifying* cause, p. 23, § 34–38; p. 24, § 41, 42; p. 54–55, § 109 *b*–117; p. 66–67, § 148; p. 75–76, § 167 *a*; p. 88, § 183, 184; p. 110, § 233; p. 222–227, § 409 *c*–411; p. 284–286, § 454–457; p.
Reflex Action, &c.—*continued.*
289, § 460–461½; p. 294, § 475; p. 295–296, § 476 *b*; p. 311–315, § 488–489; p. 317–318, § 493; p. 421–423, § 657–658; p. 483–484, § 746 *c*; p. 745–746, § 990½. Also, Vital Properties, Organic Life, *Index I.*; Respiration, Sphincter Muscles, Iris, Cathartics, &c., *Index II.*
influences the sensibility of nerves, by which it is the cause and cure of pain when not the direct result of causes acting locally, and according to the nature of the means by which it is brought into operation, whether morbific, or sedative, or loss of blood, &c., and pain is equally relieved through the same influence by Mental Emotions, and according to their nature, p. 102, § 201–202; p. 108, § 227; p. 296, § 476 *c*; p. 302, § 481 *b*; p. 323–324, § 500 *c*; p. 584–585, § 891 *d*, *e*; p. 587–590, § 891 *k*–*s*; p. 592–593, § 891½ *k*; p. 831–832, § 1057 *f*; p. 838, § 1057½; p. 862–864, § 1066. Also, Antispasmodics, Sedatives (*Aconite*), Opium, Neuralgia, Pain, Poultices, Warm Bath, Bloodletting, *Index II.*
may be brought into suddenly fatal operation upon the nervous centres either through centripetal nerves, as in blows upon the epigastrium, &c., or by mental or other causes acting directly upon those centres, when life may be instantly extinguished by their direct violence upon their organic constitution, or may be also simultaneously reflected with a corresponding fatal effect upon the whole organism, p. 107–111, § 226–233¾; p. 296, § 476 *c*; p. 298, § 476½ *h*; p. 300, § 479; p. 301, § 480; p. 302, § 481 *b*; p. 304, § 481 *g*; p. 306–308, § 483 *b*; p. 320, § 494 *dd*; p. 324, § 500 *c*, *d*; p. 334–335, § 509–511; p. 402–403, § 634–635; p. 534, § 844; p. 704, § 943 *a*–944 *a*; p. 707, § 947; p. 709, § 951 *b*–*d*; p. 831–833, § 1057 *f*, *g*; p. 858, § 1057½; p. 862–864, § 1066; p. 865–868, § 1067; p. 878–881, § 1074–1075; p. 887, § 1077. Also, Joy and Anger, Mental Emotions, Pain, Neuralgia, Opium, Antispasmodics; Serpents, Virus of; Hydrocyanic Acid; Brain, Inflammation of; Stomach, Blows upon; Bloodletting, Loss of Blood, Remedial Action, *Index II.*; Will, *Index I. and II.*
is the main cause of *hardness* and *incompressibility* of the pulse, and of buffing and cupping of blood, in inflammations, while the Loss of Blood or a Mental Emotion will speedily

Reflex Action, &c.—*continued.*
modify its influence and render it subversive of those conditions, and is also mostly the exciting cause of the various appearances presented by the tongue, and which, in both cases, as with many other symptoms, are mostly useful in denoting the special modification and force of the nervous influence, and through which is inferred the nature, seat, and force of disease, the effects of remedies, &c., p. 444–445, § 688; p. 708–710, § 951–952 *b*. Also, TONGUE, KIDNEY, URINE, SWEAT, BLOODLETTING, *Index II.*; § 500 *m*.
mistakes in regard to, from confounding the results of experiments on *trunks* of nerves with those upon their expanded extremities, p. 338, § 514 *d*; p. 347, § 516 *d*, No. 10; p. 520–521, § 826 *d*. Also, *Medical and Physiological Commentaries*, vol. i., p. 507, 563–566.
the distinction should be observed between *irritability*, and *common*, *specific*, and *sympathetic sensibility*, and that the last only is concerned in reflex action of the nervous system, and that causes affecting the nervous centres in a direct manner operate primarily through excito-motory nerves alone, p. 88–89, § 183–188 *c*; p. 100–103, § 197–204; p. 280–282, § 450–451; p. 671, § 903. Also, MENTAL EMOTIONS, DISGUST, the individual *Passions*; BRAIN, INFLAMMATION OF, *Index II.*
recent observations upon, confirming important principles in these Institutes, p. 803–808, § 1039–1045.
the coincidences in effects of reflex and direct action of the nervous system, or as the centripetal and centrifugal nerves are engaged in the former process, and the centrifugal alone in the latter, form the basis of the Author's demonstration of the substantive existence and self-acting nature of the Soul and Instinctive Principle, p. 873–910, § 1069–1082. Also, MENTAL EMOTIONS, the individual *Passions*, *Index II.*; WILL, *Index I. and II.*
employed by the Author to expound the dependence of the first act of respiration, when the point of departure is from the skin, in *Medical and Physiological Commentaries*, and again in the original Essay on the *Soul and Instinctive Principle*, and in analogical demonstration of the substantive existence and self-acting nature of the Soul in the latter work, and in the former on account of Müller's affirmation that "it appears to me to be solely the stimulus afforded to the brain and medulla oblongata *by the blood*, which immediately becomes oxydized in the lungs" (MÜLLER'S *Physiology*, p. 335), upon which the English Translator remarks, "How can the air be drawn into the lungs?"—and, in the foregoing Essay, the Author remarks that "a beautiful exemplification (of reflex action of the nervous system) is seen in the newborn infant and other animals breathing with lungs, as I have explained on a former occasion, since here the first impression is transmitted to the nervous centres through the sensitive nerves of the skin in consequence of the contact of cold air with the surface. This is the rationale of the first breath we draw, standing alone in organic life; and the same thing happens, as I also explained, when cold air or cold water, applied to the surface, reproduces breathing in syncope; or, if it be ammonia, &c., applied to the nose, then the sensitive nerves are branches of the fifth pair of cerebral. I will also now say that the function of the pneumogastric nerve is developed for the first time by the first act of inspiration, and fully developed, both as it respects the lungs and the stomach."—ESSAY ON THE SOUL AND INSTINCT, p. 57–58 (1849). Also, SKIN, LOSS OF BLOOD, SYNCOPE, *Index II.* Also, p. 406, § 638.
explains, through its primary direct development by the Will, the act of roosting and of sleeping in the erect posture, and in a manner analogous to its action upon the sphincter muscles, and employed in demonstrating the substantive existence and self-acting nature of the Soul and Principle of Instinct, p. 890–891, § 1077. Also, SPHINCTER MUSCLES, ALTERATIVES, ROOSTING, &c., *Index II.*
its physiological laws without any practical use till applied by the Author to Pathology and Therapeutics, p. 106, § 222 *b*; p. 111–112, § 334 *a*, *b*; p. 118, § 234 *h*; p. 283, § 452 *b*; p. 285–286, § 455 *d–f*; p. 296, § 476 *c*; p. 317–318, § 493 *a–d*; p. 320, § 494 *dd*; p. 329–330, § 500 *nn*; p. 341–342, § 514½ *b*; p. 515, § 819, 820; p. 579, § 890½ *c*; p. 596, § 892 *b*; p. 690–691, § 906 *g*–910; p. 361, § 530.
for the convenient reference of those who may take an interest in the Author's reclamation (p. 912), he subjoins some of the distinct claims and proofs, which for seventeen years had received universal acquiescence, of his priority in the application of the

Reflex Action, &c.—*continued.*
physiological laws of reflex action of the nervous system to Pathology and Therapeutics in all its ramifications, and of the dependence of the effects of the Mental Emotions and of the Will upon the same nervous influence, as variously presented in this work, and which application is still limited to his writings, § 111–113; § 224; § 226; § 234 *a, b;* p. 113–114, § 234 *d;* p. 116–117, § 234 *f, g;* p. 236, § 435–436; p. 262, § 446 *a;* p. 264, § 446 *d;* p. 282–284, § 451 *d*–453; p. 289, § 459 *g;* p. 295, § 476 *a;* p. 295, § 475½–476½ *b;* p. 298–299, § 477 *a;* p. 301–302, § 481 *b;* p. 309–310, § 484, No. 5; p. 318, § 493 *d;* p. 320, § 494 *dd;* p. 323–353, § 499–524; p. 357–358, § 526 *d;* p. 361–362, § 530; p. 515–516, § 819 *b*–820; p. 523, § 827 *c;* p. 592–593, § 891½ *k;* p. 643, § 893 *a;* p. 671–672, § 903, 904 *a;* p. 676–677, § 904 *c;* p. 679–681, § 905 *a;* p. 690–691, § 906 *g;* p. 692–693, § 914–921; p. 698–699, § 929–935; p. 703–710, § 940–952; p. 733–735, § 972–978; p. 745–746, § 990 *s*–990½ *b;* p. 873–891, § 1069–1077; p. 912–920, § 1084—and *Medical and Physiological Commentaries*, Articles particularly on *Bloodletting* and *Humoral Pathology*, vol. i. (1840); and on the *Modus Operandi of Remedies*, vol. iii. (1842); and as to the "*excito-secretory* action" (p. 913), which had been noticed by Bichat (p. 270, § 447 *d*), and fully established by Philip's Experiments as early as 1815 (and therefore more than twenty years prior to the cursory observations of Henle and others, who had only incidentally referred to it, p. 314–315, § 489; p. 317–318, § 493 *a–d*), the Author applies it throughout this work to all the functions which undergo any increase of their products (with the few exceptions, as in the case of vesicants, &c., where the physical agents, more than the nervous influence, are the exciting causes), and the Author carefully defines the nervous influence, both in its connexion with the secretions and all other results, as "an exciting and modifying cause," or a "vital agent," to distinguish it clearly from the organic properties upon which they essentially depend, p. 106–110, § 224–233; p. 193, § 356 *a;* p. 230–232, § 422–424; p. 262–263, § 446 *a;* p. 289, § 461; p. 294, § 475, and *references* there; p. 325–326, § 500 *ee;* p. 335–336, § 512 *a, b;* p. 350–353, § 524, No. 1, 7; p. 630–632, § 892¾ *b;* p. 667–669, § 902 *f–h;* p. 704, § 943 *a, b;* p. 733–734, § 974 *a–c;* p. 746, § 990½ *b*—and not less *sedative*, p. 107–108, § 226, 227; p. 109, § 230; p. 302–303, § 481 *c, d;* p. 507–508, § 806; p. 592–593, § 891½ *k;* p. 661–663, § 894 *b*–896; p. 746, § 990½ *b;* Sedatives, *Index II.*—but, what is incomparably more important, and alone of any value, and which the Author claims as his own, is the practical application of the laws of the nervous system to Pathology and Therapeutics, while, also, he constantly represents its reflex and direct action, when brought into unusual operation, as *altering* the natural condition of the secreted fluids and the blood by its influences upon organic processes, and uniformly expounds all the effects of remedial and morbific agents beyond the seat of their direct operation, and the analogous effects of the Mental Emotions, through its *alterative* action, and represents it as always participating, as a vital and modifying cause, in the organic processes of animals, and exerting upon the organic fluids a vitalizing influence—and it has been no less an object to array all this philosophy against the chemical, humoral, and physical doctrines, p. 193, § 356 *a;* p. 262–263, § 446 *a;* p. 289, § 461; p. 335–336, § 512 *a, b;* p. 475, § 733 *h;* p. 710–711, § 952 *b–g*—though to what extent is doubtful, p. 54–55, § 110–117; p. 108–110, § 227–233; p. 224, § 309 *g;* p. 286, § 456; p. 289, § 461; p. 303, § 481 *d;* p. 332–333, § 501–502; p. 483–484, § 746 *c;* p. 746, § 990½ *b*—nor can it be decided, p. 286–289, § 458–461; p. 296, § 476½ *b;* p. 298, § 476½ *h;* p. 300, § 479; p. 303, § 481 *e, f;* p. 342–343, § 516 *a–d;* p. 792–793, § 1032 *d.*

Religion,
distinguishes Reason from Instinct, p. 901, § 1078 *n.*

Remedial Action,
a chapter devoted to a summary review of direct and reflex action of the nervous system, as variously expounded in preceding parts of the work, and preparatory to an exposition of the modus operandi of Bloodletting, regarding it as the great alterative agent in the production and cure of diseases, modified in its nature according to the nature of each exciting cause, whether physical or mental, stimulating, depressant, or sedative, either simply so or with alterative effect, and producing through the me-

Remedial Action—*continued.*
dium of organic structure corresponding changes in the solids and fluids, p. 661–683, § 894–905. Also, Nervous Power, Sympathy, *Index I. and II.*; Reflex Action of Nervous System, Remedies; Causes, Morbific; Bloodletting, Loss of Blood, Leeching, Therapeutics, Mental Emotions, &c., *Index II.*
the whole philosophy of the operation of remedial and morbific agents rests upon physiological principles, whether as manifested through the medium of the nervous influence, or in their more independent action upon the organic constitution of parts with which they may come into contact, but differing from the natural stimuli of life not only in the greater manifestations of the nervous influence, but in the *alterative* effects which it exerts, p. 1, § 1 *a*; p. 2–4, § 2 *a*–4 *a*; p. 36–49, § 63–81; p. 54–55, § 109–117; p. 58–59, § 129 *c*–*i*; p. 61–73, § 133–163; p. 101–102, § 201–202; p. 106–112, § 223–234; p. 121–122, § 237–240; p. 147, § 330; p. 282–362, § 451–530; p. 352, § 524 *d*; p. 405–414, § 638–640; p. 541–543, § 852–854; p. 565, § 889 *f*, *g*; p. 592–593, § 891½ *k*; p. 661–667, § 894 *b*–902 *d*; p. 679–681, § 905 *a*; p. 703–710, § 940–952; p. 732–736, § 971–980; p. 745–746, § 990½; p. 131–132, § 285–288; p. 398, § 626; p. 467, § 715–719; p. 503, § 795; Reflex Action, Remedies; Causes, Morbific, *Index II.*
lying at the foundation of the whole, both of remedial and morbific action, is the *mutability* of the Organic Properties, which, in being designed for a variety of useful purposes, such as the progressive changes of organization from Infancy to Manhood, gestation, lactation, &c., is necessarily subject to deleterious influences from numerous external and internal causes, while others of a different nature are, for the same reason, and through another great law (the increased susceptibility of morbid states to the action of the latter class in such regulated modes as shall not act profoundly), capable of substituting other pathological changes, which, through another great law (the inherent tendency of the organic properties to maintain their normal state), subside spontaneously into the natural physiological conditions. See Vital Properties, *Index I.*; Causes, Morbific; Remedies, Therapeutics, the several *subdivisions* relative to the foregoing topics. Also, Pregnancy, Parturition, Lactation, Organs of Generation, *Index II.*; Youth, *Index I. and II.*
illustrations, exemplifying, by natural processes, the modus operandi of remedial and morbific agents, physical and mental, through direct and reflex action of the nervous system, p. 110, § 232; p. 230–232, § 422–426; p. 250–251, § 441 *c*; p. 262–263, § 446 *a*; p. 284–286, § 454–456; p. 296, § 476 *c*; p. 302, § 481 *b*; p. 323–328, § 500 *c*–500 *m*; p. 331–332, § 500 *o*, 501; p. 334, § 509; p. 335–341, § 512–514 *m*; p. 344–345, § 516 *d*, No. 6; p. 347–348, § 516 *d*, No. 13; p. 350–353, § 524; p. 359, § 527 *b*; p. 413, § 639 *a*; p. 565, § 889 *g*; p. 592–593, § 891½ *k*; p. 631–632, § 892¾ *b*; p. 745–746, § 990½; p. 886–891, § 1077. Also, Youth, Pregnancy, Lactation, Organs of Generation, *Index II.*
its modus operandi and of morbific causes through direct and reflex nervous action demonstrated by experiments upon the nervous system, p. 295–321, § 476–494.
the physiological laws of the cerebro-spinal and ganglionic systems introduced to illustrate and corroborate the Author's doctrine of remedial and morbific action through alterative influences of direct and reflex nervous action, p. 290–294, § 462–475; p. 335–362, § 512–530.
a special example of extensive remedial effect through alterative influence of reflex nervous action in the emetic operation of Tartarized Antimony, and where the secretions are seen to be suddenly and greatly augmented through that influence, as in the examples supplied naturally by the kidneys, skin, lachrymal gland, salivary and mammary glands, liver, &c., p. 668–669, § 902 *g*, *h*; p. 672, § 904 *a*. Also, Kidney, Skin, Urine, Bile, Milk, Loss of Blood, Weeping, Food, &c., *Index II.*
other examples of Tartarized Antimony, Mercury, and other things, of their gradually alterative action—illustrating the difference in development of reflex nervous influence from what obtains when remedies operate more abruptly—the same being also true of morbific causes, p. 669–681, § 902 *i*–905 *a*. Also, p. 111, § 233¼, 233¾; p. 285–286, § 455 *d*; p. 333, § 503–506; p. 339, § 514 *g*, *h*; p. 344–345, § 516 *d*, No. 6; p. 365, § 551; p. 366, § 556; p. 416–417, § 649 *c*; p. 420–424, § 654–661; p. 532, § 841; p. 547, § 863 *d*; p. 551, § 867; p. 568–

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569, § 889 *m, mm;* p. 592–593, § 891½ *k;* p. 599–600, § 892 *d;* p. 646–649, § 893 *e–h;* p. 661–663, § 894–896; p. 668–670, § 902 *g–m;* p. 675–676, § 904 *b.* Also, ALTERATIVES, *Index II.*
illustrations of the rapidity with which the reflex action of the nervous influence is determined with fatal effect by Hydrocyanic Acid and Strychnia—being analogous to sudden death from blows upon the epigastric region, and the shock of surgical operations, only in the former case the nervous influence is fatally modified in its nature, while in the latter it is excited only in greater intensity and suddenness, and against their supposed absorption, p. 176, § 350½ *p;* p. 298, § 476½ *h;* p. 320, § 494 *dd;* p. 523–524, § 827 *d;* p. 670, § 902 *l;* p. 672, § 904 *b*—and illustrations, in connexion with the foregoing, of the corresponding modus operandi of Opium, Hyoscyamus, Atropia, Tobacco, Belladonna, Rhus vernix, p. 338, § 516 *d*, No. 13; p. 592–593, § 891½ *k;* p. 673–675—and farther illustrations of the efficient instrumentality of the nervous influence when syncope or death is suddenly brought on, or disease suddenly arrested by loss of blood or by mental emotions—all showing how the nervous influence may be determined directly upon the organic constitution of the nervous system, as well as upon other organs, either by the suddenness of the shock or by special virtues of morbific causes, and all conspiring together in showing that a common cause is the immediate agent, p. 109, § 230; p. 298, § 476½ *h;* p. 304, § 481 *g;* p. 307–308, § 483 *c;* p. 334–335, § 509–511; p. 662–663, § 895, 896; p. 703–704, § 942 *b;* p. 706–707, § 947–948; p. 709, § 951 *b*—and associate with the foregoing the sudden death of warm-blooded animals from the bite of venomous reptiles, and which was shown by Girtanner, and again by Van Deen and Stilling, to be as quickly fatal in eviscerated frogs as in the entire, p. 319, § 494 *b;* p. 325–326, § 828 *b–d*—to all of which Chemistry is desired to render an intelligible answer, if it can, consulting, also, in the same connexion, REFLEX ACTION, MENTAL EMOTIONS, JOY AND ANGER, FEAR, DISGUST; STOMACH, BLOWS UPON; HYDROCYANIC ACID, ANTISPASMODICS, SEDATIVES (*Aconite*), OPIUM, TOBACCO, CANTHARIDES, BLOODLETTING, LOSS OF BLOOD, *Index II.*

Remedial Action—*continued.*
statement by PEREIRA that "the fact is that in the present state of our knowledge we cannot explain the *modus medendi* of a large number of our best and most certain remedial agents," and that "the *methodus medendi* of Cinchona, in its cure of intermittents, is quite inexplicable," considered in relation to Cinchona by interrogating its *methodus medendi* as a Tonic in opposition to the doctrine of "*augmentation of cohesion of the organic* mass," as in the process of tanning, and thence deducing its operation in all forms of disease, and of all other remedies, through alterative action of reflex nervous influence, and farther illustrated as an antiperiodic by comparison with the antidotal nature of Coffee and the Cold dash in poisoning by Opium, and of Antispasmodics in cases of spasm, and by the morbific and curative effects of a Seton, and converting the whole to one common account, which is relative to variously modified conditions of reflex nervous action according to the nature of the causes by which it is brought into preternatural operation, and the nature of the pathological conditions, p. 338, § 514 *d;* p. 592–593, § 891½ *k;* p. 596–597, § 892 *b, c;* p. 676–681, § 904 *c*–905 *a;* p. 737–738, § 984 *b.* Also, p. 67, § 149–151; p. 73, § 163; p. 108–110, § 227–232; p. 542, § 854 *c–e;* p. 554, § 871; p. 661–663, § 894–896; p. 664–665, § 900–901.
modus operandi of warm poultices and hot fomentations considered through a series of analogies in relation to other remedies, till we arrive at these most simple, but important auxiliaries in establishing the restorative disposition, p. 681–683, § 905 *b.* Also, POULTICES, *Index II.*
the supposed absorption of blue mercurial ointment contradicted by the failure to detect the metal in the solids or fluids, and in being useful in cases of indurated tumours only when applied directly over them, and the statement in Pereira's Materia Medica, which expresses the common doctrine that "the occasional use of the warm bath promotes an *absorption* of the blue mercurial ointment when applied to the skin," is remote from the philosophy which refers the greater effects of the mercurial to an increased susceptibility of the skin and system at large, which the warm bath alone "promotes," and which is more effectually promoted by loss of blood and cathartics when mercury is ad-

Remedial Action—*continued.*
ministered internally, p. 367, § 556 *c;* p. 520, § 826 *c;* p. 524, § 827 *e.* Also, Mercurial Remedies, *Index II.*
modus operandi of open air, change of air, exercise, &c., in their curative effects through complex influences of reflex nervous action, p. 543, § 855; p. 670–671, § 902 *m.* Also, p. 335–336, § 512 *a, b;* p. 351–352, § 524 *c;* p. 354, § 525 *c;* p. 359, § 527 *b;* p. 421–422, § 657 *a;* p. 685, § 905½ *b.* Also, Exercise, Phthisis, Whooping-Cough, Ulcers, Food, Alteratives, Amenorrhœa, *Index II.*
demonstration of the coincident effects of *direct* and *reflex* action of the nervous system when brought into simple operation in voluntary and involuntary respiration, and in the voluntary and involuntary contraction of the sphincter muscles, and carried as the fundamental philosophy to the interpretation of the modus operandi of Mental Emotions and of physical causes in the production and cure of disease through the same direct and reflex nervous action, and in proof, also, of the substantive existence and self-acting nature of the Soul and Principle of Instinct, p. 106–112, § 222–234; p. 124–125, § 243–246; p. 296, § 476 *c;* p. 302, § 481 *b;* p. 323–330, § 500 *c–nn;* p. 338, 339, § 514 *d, g, h;* p. 662, § 896; p. 666–670, § 902 *b–m;* p. 874–881, § 1071–1075. Also, Mental Emotions, Respiration, Sphincter Muscles, Iris, &c., *Index II.*
distinction between the foregoing effects of the nervous influence in the natural processes and in the operation of remedial and morbific causes, physical and mental—that, in the latter cases, the influence is *alterative*, and attended by complex circles of reflex action of the nervous system, and exemplified by Cathartics, Emetics, Counter-Irritants, Grief, Hope, &c., p. 67–68, § 149–152 *a;* p. 121–122, § 237–240; p. 296, § 476 *c;* p. 323–324, § 500 *c, d;* p. 563–566, § 889 *a–g;* p. 568–569, § 889 *m, mm;* p. 592–593, § 891½ *k;* p. 646–650, § 893 *c–i;* p. 666–672, § 902 *b*–904 *b;* p. 746, § 990½ *b.*
organs not morbidly affected which may be brought under the influence of remedies contribute to the cure of such as are diseased, through the alterative influence of reflex nervous action, the latter organs being now rendered susceptible of such influences by their morbid states, and the influences thus propagated will depend upon the nature of the remedy, as, for example, Tartarized Antimony will establish a powerful reflected influence from the skin, though it do not induce sweating, but Hot Water taken internally, and Fear, will exert no effect, though they bathe the skin with perspiration, while the compound powder of Ipecacuanha and Opium, though it establish free diaphoresis, may prove morbific in the same cases—showing, also, that the same principle holds with morbific causes, while there follows in the example before us, and in other instances where the skin is likely to contribute to the curative process (as in the cases of Cathartics), and along with other facts, a practical corollary that the skin participates far more than is apt to be supposed, not only in remedial influences, but in morbific, and that it should not be impaired in the former function by exposure to cold, but rather promoted by the warmth of a bed; and the following sections, as with all other references, have a direct or an illustrative bearing upon the subject, p. 55, § 117; p. 59, § 129 *i;* p. 63, § 137 *d;* p. 65, § 143 *c;* p. 66–67, § 148; p. 68, § 152 *a, b;* p. 230–232, § 422–424; p. 285–286, § 455 *c–f;* p. 302–303, § 481 *c–e;* p. 308–310, § 484; p. 319–320, § 494 *d, dd;* p. 335–336, § 512 *a, b;* p. 338, § 514 *d;* p. 339–340, § 514 *h;* p. 350–353, § 524 *a–d;* p. 360–361, § 528; p. 421–422, § 657 *a;* p. 451, § 692 *a;* p. 465–466, § 715; p. 538–539, § 847 *g*–848; p. 546–550, § 863 *a–f;* p. 563–564, § 889 *a;* p. 565, § 889 *g;* p. 570, § 889 *n;* p. 633–635, § 892⅘ *a–c;* p. 637, § 892⅘ *d, e;* p. 667–669, § 902 *e–i;* § 956. Skin, Cold, Miasm, Whooping-Cough, Phthisis, Shower-Bath, Counter-Irritants, *Index II.*
the occurrence of a secondary or sympathetic disease is sometimes followed by a subsidence of a primary affection upon which the secondary depends, as a consequence of alterative reflex nervous actions which are analogous to such as are instituted by counter-irritants, though in a general sense the primary affection gets no benefit, but the contrary, from secondary developments, p. 65–66, § 143 *e,* and *references* there; p. 67, § 148; p. 351–352, § 524 *c;* p. 360, § 528; p. 421–422, § 657; p. 506, § 804; p. 539, § 848; p. 570, § 889 *n;* p. 652–654, § 893 *n;* p. 679–681, § 905 *a.* Also, Metastasis, Poultices, *Index II.*

Remedial Action—*continued.*
as displayed by the MENTAL EMOTIONS, whether in their primary connexion with excito-motory nerves alone, or as they give rise to subsequent developments of reflex nervous action (see MENTAL EMOTIONS and DISGUST, *Index II.*), a perfect correspondence is seen between their effects and those of physical causes, operating alike upon distant parts, or upon the organic constitution of the nervous centres, with both morbific and remedial effect, or as anger and joy may extinguish life in the same sudden manner as a blow upon the head, or through those more complex nervous influences that spring from a blow upon the region of the stomach, or from the shock of a surgical operation, or from drinking cold water in "a heated state of the body," or from hydrocyanic acid; and we unavoidably deduce from the vast variety of effects according to the nature of the emotion or the physical cause, and from the exact coincidences in all their effects, the certainty of an immediate cause appertaining to the nervous system and its endless modifications according to the nature of the remote exciting cause, and looking alone at the mental emotions and those physical causes which are incapable of absorption, and at the diseases which grow consecutively out of each other, we are constrained by all the immense amount of proof which is thus supplied to carry it analogically to the interpretation of the modus operandi of all other remedial and morbific agents through alterative influences of that same reflex action of the nervous system upon all parts beyond the seat of their direct operation, and may finally appeal for the same testimony to the natural stimuli of life, to the blood as it maintains the action of the heart through the same process of reflex nervous influence, and so of the urine and the bladder, the fæces and the sphincter ani, the motions of the iris, the sneezing as induced by snuff and the sun's light, the process of respiration, the act of deglutition, and as some are imitated and others influenced by the will, and as the genital organs unfold the peculiarities of youth, as pregnancy nauseates the stomach and develops the mammary glands, and as parturition starts the flow of milk and leaves the uterine system in a condition to perpetually excite a reflex nervous influence that shall maintain the secretion till menstruation terminates the process, while, also, the stimulus of suction propagates a reflex nervous influence upon the uterine organs, and maintains them in a condition to carry out the final cause of lactation—or, turning to the natural displays of the mind, we may pursue the coincidences between the effects of fear and the contact of cold with the surface of the body in starting on the instant the secretion of urine, or as the odor of food, or its expectation, and its presence in the stomach equally determine an exciting nervous influence upon the salivary glands, and as grief and sneezing alike give rise to tears, and as the sun's light and thinking of the paroxysm occasion sneezing, and as disgust and its recollection, and an emetic, and tickling the fauces alike produce vomiting—and we conclude by commending, in connexion with the foregoing, the following sections, which are mostly relative to the Mental Emotions and the Will, to the candid attention of the Organic Chemist and the impartial Materialist, the former of whom will find these workings of the mind through the nervous influence applied in a great variety of modes as parallel examples with the influences of physical agents on life, and designed to illustrate the modus operandi of morbific and remedial agents of every denomination and shade, and the latter an irrefutable demonstration, as the Author believes, of the substantive existence and self-acting nature of the Soul, p. 89, § 188; p. 95, § 188½ *d*; p. 104, § 215; p. 107, § 227; p. 108–110, § 228; p. 111, § 233¾; p. 124–125, § 243–246; p. 128, § 226, 227; p. 230, § 422 *b*; p. 263, § 446 *a*; p. 281, § 451 *a*; p. 296, § 476 *c*; p. 298, § 476½ *h*; p. 300–302, § 479, 480, 481 *b*; p. 312–313, § 487 *g*, *h*; p. 314, § 488½; p. 323–331, § 500 *c–o*; p. 334–336, § 507–513; p. 337, § 514 *c*; p. 338, § 514 *f*; p. 340–341, § 514 *l*, *m*; p. 356, § 526 *c*; p. 369–370, § 565–568; p. 378–381, § 578 *d*–579; p. 382, § 581 *c–e*; p. 387, § 597 *d*; p. 388, § 598 *d*; p. 390, § 600 *b*, 601 *c*; p. 417, § 649 *c*; p. 478, § 740 *a*; p. 523, § 827 *c*; p. 525–526, § 828 *a–c*; p. 527, § 828 *e*; p. 530, § 837 *b*; p. 534, § 844; p. 547, § 863 *d*; p. 580, § 890½ *d*; p. 586, § 891 *g*, *h*; p. 589–590, § 891 *p*; p. 592–593, § 891½ *k*; p. 624, § 892¾ *d*; p. 631–632, § 892¾ *b*, *c*; p. 662–663, § 896; p. 664, § 900; p. 670–672, § 903–904 *a*; p. 674, § 904 *b*; p. 675,

Remedial Action—*continued.*
§ 904 *b*; p. 681–682, § 905 *d*; p. 701, § 938 *b*; p. 704, § 943 *b*–944 *a*; p. 707, § 947; p. 709, § 951 *d*; p. 714, § 958 *b*; p. 733, § 974 *c*; p. 734–735, § 975 *b*–976; p. 745–746, § 960½ *a*, *b*; p. 804, § 1040; p. 865–868, § 1067; p. 874, § 1071; p. 875–881, § 1072–1075; p. 886–891, § 1077. Also, the several topics alluded to in the foregoing preamble, as embraced in *Index II.*
illustrated in all its phases by the modus operandi of Setons, whose variety of effects manifest all that is essentially relative to the operation of all remedial and morbific agents, physical and mental, and as well in respect to the direct local action of physical causes as to their influences through the medium of reflex action of the nervous system, and exemplifying also the distinction made by the Author between the transient operation of the nervous influence as brought into effect by a single or interrupted applications of remedial and morbific agents and by their undisturbed or but temporarily suspended application, p. 679–681, § 905 *a*; p. 668–669, § 902 *g–i*. Also, Alteratives; Antimony, Tartarized; Sphincter Muscles, Roosting, *Index II.*
if disease be limited to a part on which remedies make their direct impression, the change may then be instituted by the direct action of the cause upon the organic states of the part (the nerves, however, participating more or less, p. 475, § 733 *h*; p. 483–484, § 746 *c*), and which may be also true of morbific causes in their production of disease, as seen, in either case, of the curative or morbific effects of caustics, &c.; but it more commonly happens that a reflected nervous influence upon the part is the immediate agent, p. 66–68, § 148; p. 422–423, § 658. Also, Remedies, where this subject is illustrated through numerous references, *Index II.*; § 514 *b.*
distinctions to be observed between impressions made on *irritability*, and *common*, *specific*, and *sympathetic sensibility*, and that the last only is concerned in reflex action of the nervous system, while causes affecting the nervous centres in a direct manner operate primarily through excito-motory nerves alone, p. 671, § 903. Also, p. 88–90, § 183–188 *c*; p. 100–103, § 197–204; p. 280–282. § 450–451; Mental Emotions, Reflex Action, individual *Passions*, Disgust; Brain, Inflammation of, *Index II.*

Remedial Action—*continued.*
the fundamental philosophy of disease and its cure, according to the Author's interpretation, is perfectly simple, but involves very complex laws and details, consisting in the former respect of certain changes in the natural physiological conditions, and in the latter of introducing other pathological changes that shall subside spontaneously into the natural conditions, p. 3–4, § 2 *b–d*; p. 331, § 500 *o*; p. 122, § 239, 240; p. 333, § 503–505; p. 352, § 524 *d*; p. 413–414, § 639–640; p. 427, § 667–669; p. 473–474, § 733 *e*, *f*; p. 531, § 839; p. 535–539, § 847–850; p. 541, § 852–854 *b*; p. 542, § 854 *c–e*; p. 544–545, § 858–859 *a*; p. 592–593, § 891½ *k*; p. 662, § 895; p. 663–665, § 897–901; p. 646, § 893 *e*; p. 652, § 893 *l*; p. 679, § 905. Remedies; Causes, Morbific; Therapeutics; Diseases, Self-Limited; Small-Pox, Structure, *Index II.*
may introduce a variety of pathological changes in any existing disease, either of which may be adequate to the cure, since all remedies operate by establishing morbid states that will soon subside spontaneously, the reflex nervous influence through which the changes are effected being modified according to the special virtues of every remedy (which includes the dose, the nature of the disease, contingent influences, &c.), and hence the reason why loss of blood, cathartics, tartarized antimony, mercury, ipecacuanha, counter-irritants, syncope from mental emotions, &c., will alike remove *common* inflammation, and certain "specifics" (cinchona, arsenic, guaiacum, colchicum, iodine) *specific* forms of inflammation when they would increase common inflammation, and cinchona, arsenic, a shock of the mind, and many other things whose chemical and other physical properties are totally different from each other will break up an intermittent fever, and which are also propounded as problems for Organic Chemistry, p. 107–111, § 227–233¾; p. 333, § 503–505; p. 417, § 649 *c*, 650; p. 424–425, § 662 *a–e*; p. 428, § 671–674; p. 486, § 750 *b*; p. 542, § 854 *c–e*; p. 544, § 857; p. 545–546, § 859 *b*–861; p. 547–550, § 863 *d*; p. 553, § 870 *aa*; p. 596–597, § 892 *b*, *c*; p. 604–606, § 892 *m–p*; p. 611–612, § 892¼ *f–i*; p. 659, § 893 *q*; p. 662–665, § 896–901; p. 709, § 951 *b*; p. 737, § 984; § 892 *b*; § 892½ *v*; § 904 *d*; § 1059. Mental Emo-

Remedial Action—*continued.*
tions, Joy and Anger, Fear, Hope, Disgust, &c., *Index II.*
in very complex conditions of disease, as idiopathic fever attended by inflammations of many parts, the relations between the morbid states may be such that a single remedy, as loss of blood, tartarized antimony, or mercury, may overthrow the entire assemblage, p. 63, § 147 *c–e*; p. 65, § 143 *c*; p. 66–67, § 148–151; p. 298, § 476½ *h*; p. 337, § 514 *b, c*; p. 367, § 557 *a, b*; p. 465–466, § 715; p. 538, § 847 *g*; p. 552–554, § 869–871; p. 662–664, § 895–900; p. 731–732, § 970 *c*; p. 739–740, § 986–987.

Remedies—continued from *Index I.*,
operate through the natural laws which govern organic processes in the animal kingdom, as do also morbific causes, but bring into preternatural effect the nervous influence. See this *subdivision* under Reflex Action of the Nervous System. Also, Humoral Pathology, Chemical Physiologists, *Index II.*; Organic Chemistry, *Index I. and II.*
should be addressed to the pathological conditions as denoted by the whole assemblage of symptoms, and not to isolated ones, p. 65–67, § 143 *c*–151; p. 73, § 163; p. 147, § 330; p. 424–425, § 661–662; p. 428, § 694 *a*; p. 430–433, § 675–676 *a*; p. 437–442, § 684–686; p. 456–460, § 695–708; p. 479–480, § 471 *a, b*; p. 486, § 750 *b*; p. 487–489, § 756; p. 498–499, § 785; p. 505, § 801; p. 510, § 813 *b*; p. 541–542, § 854 *bb*; p. 545, § 859 *b*; p. 548–550, § 863 *d*; p. 551–554, § 867–871; p. 560–561, § 886–888; p. 597–600, § 892 *c, d*; p. 603–604, § 892 *k*; p. 606, § 892 *p*; p. 609–610, § 892¼ *d*; p. 613, § 892½ *c*; p. 615–617, § 892½ *f–k*; p. 636–642, § 892¾ *d–i*; p. 663–665, § 897–901; p. 724–728, § 961; p. 729–732, § 966–970; p. 732–736, § 971–980.
by their impression upon parts with which they come in contact, if their nature admit of it, or according to other impressions arising from loss of blood, exercise, &c., influences are transmitted through sensitive fibres of compound nerves (mainly of the sympathetic) to the cerebro-spinal axis, which rouse and reflect the nervous influence upon various parts of the organism, but particularly upon the seats of disease, and when Mental Emotions give rise to analogous effects, the principle is the same, only the influence is now primarily exerted directly upon the nervous centres and

Remedies—*continued.*
the first movement centrifugal, and what is true in this respect of remedies is equally so of morbific causes, p. 88, § 183–185; p. 89, § 188 *a, b*; p. 95, § 188½ *d*, 189 *a*; p. 96–98, § 189 *c*–191 *b*; p. 101–103, § 201–208; p. 106–112, § 222–234 *b*; p. 230–231, § 422–423; p. 253, § 441 *d*; p. 262–270, § 446 *a*–447 *d*; p. 282, § 451 *f*; p. 283–284, § 452 *c*, 453; p. 285–286, § 455 *d*–457; p. 289, § 459 *g*; p. 295, § 476 *a*; p. 296, § 476 *c*, 476½ *b*; p. 298–299, § 477 *a*; p. 301–303, § 481 *b–d*; p. 309–310, § 484 *b*–485; p. 312–314, § 487 *g*–488½; p. 315–318, § 492–493; p. 320, § 494 *dd*; p. 321, § 496, 497; p. 323–362, § 499–530; p. 364, § 547; p. 415–417, § 649; p. 421–423, § 657–658; p. 430–432, § 675; p. 451, § 691–692; p. 478–479, § 740–741; p. 509, § 811; p. 515–516, § 819 *b*–820; p. 522–523, § 827 *b, c*; p. 530–533, § 837 *b*–841; p. 534, § 844; p. 541–542, § 854 *bb*; p. 544, § 857; p. 545, § 859 *a–c*; p. 547–550, § 863 *d*; p. 551–553, § 867–870; p. 553, § 870 *aa*; p. 554–556, § 872; p. 592–593, § 891 *k*; p. 644–652, § 893 *c–m*; p. 661–683, § 894–905; p. 692–693, § 914–921; p. 698–699, § 929–935; p. 703–710, § 940–952; p. 724–728, § 961–964; p. 732–736, § 972–980; p. 745–746, § 990 *s*–990½ *b*; p. 766–767, § 1009 *a, b*; p. 862–868, § 1066–1067.
operate through influences of reflex nervous action according to *structure* and *special vital constitution of different parts* (some remedies affecting particular tissues as united in certain compound organs only, or only particular parts of a continuous tissue), and according to the *changes they undergo from infancy to adult age*, and *temperament*, and especially as they may be *diverted by morbid states* from their natural condition, which renders them more susceptible of remedial influences, but also according to the natural stimuli of life, though differing from the natural not only in the far greater manifestations of the reflex nervous influence, but in the *alterative* effect it exerts in diseased states of the body—the same being true in principle of morbific causes; while, also, many natural stimuli, especially food, may be profoundly morbific or curative in diseased states of the body, p. 3, § 2 *b*; p. 55, § 113–117; p. 59, § 129 *g–i*; p. 61–73, § 133–161; p. 98, § 191 *b*; p. 120–122, § 237–240; p. 130, § 278; p. 231, § 422 *c*–424; p. 284–289, § 454–461; p. 352,

Remedies—*continued.*
§ 524 *d;* p. 354–361, § 526–530; p. 364, § 548; p. 365–368, § 551–560; p. 373–390, § 574–601; p. 399, § 630; p. 415–416, § 648 *d*–649 *b;* p. 418, § 651 *a, b;* p. 421–422, § 657 *a, b;* p. 424, § 662; p. 425, § 663; p. 428, § 671; p. 435, § 680; p. 467, § 718; p. 468–469, § 722; p. 502–504, § 793–798; p. 509, § 811; p. 520–521, § 826 *d;* p. 522–523, § 827 *b, c;* p. 530, § 837 *b;* p. 535–539, § 847–850; p. 541–542, § 854 *bb;* p. 543, § 855; p. 545, § 859 *a–c;* p. 553, § 870 *aa;* p. 554, § 871; p. 565–566, § 889 *g, i;* p. 579–580, § 890½ *d;* p. 597–598, § 892 *c;* p. 612, § 892½ *a;* p. 624, § 892⅝ *d;* p. 634–636, § 892¾ *b, c;* p. 647, § 893 *c;* p. 649, § 893 *h;* p. 651, § 893 *k;* p. 657–659, § 893 *p, q;* p. 661–665, § 894–900; p. 669, § 902 *i;* p. 676–679, § 904 *c, d;* p. 703–711, § 940–952; p. 731, § 970 *c;* p. 732–736, § 972–980; p. 745–746, § 990½; p. 864, § 1066.

distinction in the natural constitution of different tissues and of parts of a continuous tissue, and of compound organs of which they form component parts, illustrated by natural stimuli, and by their products, and by their disturbing influences when morbidly affected, p. 61, § 132–133 *b;* p. 62–68, § 135–152, and *references* there, and *ut supra*—and farther illustrated by the effects of Aloes (showing that it does not act particularly, as generally supposed, upon the rectum, but mostly on the small intestine), p. 467, § 718; p. 566, § 889 *i;* p. 856–857, § 1063 *b;* also, p. 565–566, § 889 *g*—and by other cathartics, Rhubarb, Senna, the Saline, Calomel, Jalap, &c., according to the special virtues of each, their doses and combinations, p. 554–556, § 872 *a;* p. 566, § 889 *i;* p. 568–569, § 889 *m, mm;* p. 571, § 890 *b;* p. 575, § 890 *i;* p. 838–861, § 1058–1065—and by Tartarized Antimony, Cantharides, Iodine, Ergot, and numerous other individual substances. See the *Articles, Index II.*

tabular views of the foregoing considerations relative to peculiarities of structure as they respect the operation of remedies and morbific causes, and in the relation of tissues to compound organs, illustrated by their relative liability to inflammation in different parts, and the relative degrees of danger, and the relative exigencies for loss of blood as the disease may affect one part or another, p. 69–73, § 160–162.

Remedies—*continued.*
render the nervous influence *alterative, excitant, sedative,* or simply *depressant,* according to the nature of each one (which includes the dose, combinations, &c., and the modifying influences of disease and surrounding circumstances), and this whether it operate through reflex action, as in the case of external causes, or in a direct manner, as with mental emotions—and so, also, with morbific causes, p. 95, § 188½ *d;* p. 107–111, § 226–233¾; p. 253, § 441 *d;* p. 296, § 476 *c;* p. 301–305, § 481 *b*–482; p. 306, § 483; p. 315, § 492; p. 323–353, § 500 *c*–524; p. 365–366, § 551–556; p. 427–428, § 670, 671; p. 430–433, § 675; p. 480, § 743; p. 509, § 811; p. 512, § 817; p. 523, § 827; p. 534, § 844; p. 565, § 889 *f, g;* p. 570, § 889 *n;* p. 657, § 893 *p;* p. 661–663, § 894–896; p. 666–672, § 902 *b*–904 *a;* p. 724–727, § 961–963; p. 733–735, § 974–976; p. 773–775, § 1023–1024; p. 829, § 1057 *a;* p. 865–868, § 1067.

their operation through alterative influence of reflex nervous action rendered manifest by the special relations of the alimentary canal to the nervous system, and other special anatomical provisions, p. 335–336, § 512 *a*–513; p. 565–566, § 889 *g.* Also, Mucous Tissue, first *subdivision,* Lacteals, *Index II.*

what general considerations should determine the use of one remedy or another, and other relative things, p. 430–433, § 675; p. 438–442, § 688 *b–d;* p. 540, § 851; p. 543–544, § 857; p. 545, § 859 *b;* p. 556–557, § 873–875; p. 560–562, § 885–888; p. 567–568, § 889 *l;* p. 570, § 889 *n;* p. 600, § 892 *d;* p. 605, § 892 *m;* p. 740, § 989.

according to the nature of each one, or of two or more in combination, and according to the number of constituent parts, respectively, a new remedy is created, which enables us to greatly simplify the Materia Medica, and exemplified—showing, also, the importance of extemporaneous prescriptions, and the injurious tendency of standing formulæ, and how the reflex nervous influence may be variously directed in the cure of diseases by artificial means—and what is true of the effects of one, or more remedies in combination, or in consecutive order, is also, in principle, of morbific causes, p. 27, § 52; p. 94–95, § 188½ *d;* p. 107–110, § 227–232; p. 340, § 514 *h;* p. 417, § 650; p. 418–419, § 652 *b*–653 *c;* p. 424–425, § 662–663; p. 545, § 860; p. 547, § 863 *d;* p. 554

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–556, § 872 *a*; p. 566–567, § 889 *k*; p. 661–662, § 894; p. 838–841, § 1058; p. 851–862, § 1060–1065.
combinations and uses of, and their philosophy in variously modifying the alterative influence of reflex nervous action, *ibid.*
often possess compound virtues, when they should be regarded as acting as a whole; but one of the virtues, although in opposition to each other, may take full effect without the others being manifested, according to the nature of the pathological conditions, as, either the tonic or antiphlogistic virtue of Cinchona may be fully in the ascendant in the same disease, or the tonic, stimulating, antiphlogistic, or astringent virtue of Rhubarb—such remedies being also distributed in the Author's *Therapeutical Arrangement of the Materia Medica* into as many different groups as they are distinguished for two or more virtues, p. 424, § 662 *b*; p. 430–433, § 675; p. 487–489, § 756 *a, b*; p. 553, § 870 *aa*; p. 554–556, § 872 *a*; p. 571–572, § 890 *b*; p. 575, § 890 *i, k*; p. 581, § 890½ *e*; p. 597–598, § 892 *c*; p. 605–607, § 892 *m–r*; p. 611, § 892½ *h*; p. 855, § 1062.
the right doses of, and the extent of other means, next in importance to the right remedies, but often of very difficult adjustment, and some examples—also, against the chemical and other physical hypotheses, and demonstrative of the accuracy of the Author's doctrine of their operation through alterative influence of reflex nervous action, p. 532–533, § 841; p. 543–544, § 857; p. 553, § 870 *aa*; p. 566–569, § 889 *k–mm*; p. 598–604, § 892 *d–k*; p. 650–651, § 893 *i–k*; p. 672, § 904 *a*; p. 675–676, § 904 *b*; p. 711–714, § 954–958; p. 726–728, § 961 *c*–964 *c*; p. 729–730, § 968–969; p. 733–736, § 974–980; p. 748–749, § 992 *b, c*; p. 750–751, § 994–999; p. 840–841, § 1058 *d*; p. 870–872, § 1068 *c, d*.
time and order of their administration next in importance, and variously exemplified, p. 367, § 556 *c*; p. 428, § 672; p. 430–433, § 675–676 *a*; p. 548–549, § 863 *d*; p. 551–554, § 867–871; p. 570, § 889 *n*; p. 595–596, § 892 *aa*; p. 595–598, § 892; p. 600, § 892 *d*; p. 641–642, § 892⅘ *i*; p. 648–649, § 893 *g, h*; p. 658–659, § 893 *p*; p. 728, § 964 *d*; p. 841, § 1058 *e*.
in disease, their action is on common ground with morbific agents, physical and mental, and the natural stimuli of life, all of which operate with increased intensity in morbid states, and according to the varying susceptibilities, and many remedies, such as tartarized antimony, iodine, ergot, arsenic, &c., which are powerfully curative in their smallest doses, exert no effect in such doses upon healthy organs, and being alike true whether operating upon the organic constitution of parts or through reflex action of the nervous system, a simple exemplification of the whole of which is seen in the failure of a mild solution of the acetate of lead to produce any effect upon the tunica conjunctiva in its natural state, which may quickly remove a mild inflammation of the membrane, or, on the contrary, aggravate to a more intense degree, and connecting this with the curative and morbific effects of a *Seton* upon the same disease when inserted in the nape of the neck (p. 679–681, § 905 *a*), we arrive at the combined aspect of the operation of remedies through alterative influences of reflex nervous action, either for good or for evil, upon parts concealed from observation, and upon their organic constitution, and according to the increased and varying susceptibilities arising from disease, as well also according to the natural constitution of the affected parts, p. 3, § 2 *b*; p. 59, § 129 *h*; p. 63, § 137 *d*; p. 65, § 143 *c*; p. 67, § 149–151; p. 68, § 152 *b*; p. 120–122, § 237–240; p. 332–334, § 502–506; p. 339–340, § 514 *g, h*; p. 352, § 524 *d*; p. 415–417, § 649 *a–d*; p. 421–423, § 657–658; p. 435, § 680; p. 456, § 698; p. 465–466, § 715; p. 482, § 744; p. 509, § 810; p. 531, § 838–840; p. 535–539, § 847–850; p. 541–542, § 854 *bb*; p. 545, § 859 *a, b*; p. 553, § 870 *aa*; p. 607–608, § 892 *a, b*; p. 612, § 892½ *a*; p. 623, § 892¾ *c*; p. 665–671, § 902 *a–m*; p. 709, § 951 *b–d*; p. 724–726, § 961 *a–e*; p. 733–736, § 974–980.
from the foregoing and other premises of a fundamental nature we reach the conclusion that if disease be limited to the part upon which remedies make their direct impression, the salutary influence may be exerted mostly upon the organic states without the intervention of the nervous influence, excepting so far as the nerves constitute a part of the structure, which is particularly true of a few remedies which are intended to be thus restricted, such as caustics, and many applications to cutaneous diseases; but it is in respect to most

Remedies—*continued.*
remedies, as with most morbific causes in their production of disease in parts upon which their direct morbific impression is made, that, in the former case, the curative effect upon a diseased part as it respects the direct impression is greatly the result of an alterative reflex nervous influence reverberated through the appropriate nerves of the part, or as the remedy or morbific cause may institute sources of reflex action in other parts—all of which may be illustrated by the act of vomiting, whether produced by an emetic, or the gravid uterus, or disease of the kidney, or tobacco applied to the surface, or tickling the fauces, or by a mental emotion, when, in all the cases, a reflex action is reverberated upon the stomach through the excito-motory fibres of the same nerve that transmitted the primary impression to the nervous centres, p. 66–67, § 148; p. 89, § 188 *a*; p. 102, § 203; p. 284–287, § 453 *c*–459; p. 289, § 461; p. 296, § 476 *c*; p. 302, § 481 *b*; p. 315–316, § 492; p. 323–324, § 500 *c*; p. 327, § 500 *i*; p. 338, § 514 *d*; p. 339–341, § 514 *g*–*m*; p. 347–348, § 516 *d*, Nos. 11–13; p. 416–417, § 649 *c*; p. 421–423, § 657 *a*–658; p. 475, § 733 *h*; p. 483–484, § 746; p. 522–523, § 827 *b*, *c*; p. 531, § 840; p. 547–550, § 863 *d*; p. 666–672, § 902 *b*–904 *b*, p. 336, § 514 *b*.
the foregoing inquiry has been introduced under the Article Remedial Action by a reference to certain sections where the modus operandi of Cinchona and Mercury and some other things is shown to depend upon alterative influences of reflex nervous action, and we may now look at other sections relative mostly to Tartarized Antimony, partly for the purpose of illustrating what is known as the *cumulative* effect of remedies (that is to say, when their effects are not particularly manifested until after a number of doses, and there may be then a sudden and powerful display of a curative or morbific nature), and in part as a farther demonstration against the doctrine of operation by absorption, since, if it be allowed that the medicine is absorbed, all its influences upon disease may be shown to depend on its action upon the stomach and consequent reflex actions of the nervous system—for if the doctrine of absorption were true, it should not be necessary to carry its small therapeutical doses to near the point of nausea to subdue inflammations and febrile excitements, while it is one of the most familiar facts that the dose must generally be gradually increased, often from the sixteenth of a grain to half a grain or more, to maintain the effect upon disease, the skin, general excitement, &c., which was originally produced by the smallest dose; but so long as the sixteenth or the fourth of a grain manifest an approximation to the point of nausea, it will as effectually break down arterial excitement, produce perspiration, and overthrow pneumonia as effectually as when two grains may be necessary to the same amount of impression upon the stomach, and without which the symptoms will again increase—and also exemplified to the same effect by the manner in which it overcomes croup, in which affection no relief will follow till it produce some degree of nausea, whatever the quantity exhibited, but as soon as its nauseating influence is felt, the well-marked symptoms of the disease begin to yield, and rapidly so when vomiting ensues, showing that the whole effect is due to the influence upon the stomach, which determines the act of vomiting—and, finally, according to the doctrine of absorption, there should be no necessity whatever between this gastric irritation and the salutary effects of the remedy, and the only rule should be to introduce a certain quantity into the circulation, p. 344–345, § 516 *d*, No. 6; p. 351, § 524 *a*, No. 1; p. 355, § 526 *a*; p. 356–357, § 514 *b*, *c*; p. 365–368, § 549–559; p. 431, § 675; p. 486, § 750 *b*; p. 530–533, § 837 *b*–841; p. 547, § 863 *d*; p. 556–557, § 873; p. 567–569, § 889 *l*–*mm*; p. 612–613, § 892½ *a*, *b*; p. 634, § 892⅘ *b*; p. 638–640, § 892⅘ *g*; p. 641, § 892⅘ *i*; p. 666–670, § § 902 *b*–*m*; p. 675–676, § 904 *b*; p. 833, § 1057 *h*; p. 850–851, § 1059.
physiological distinctions between Cathartics and Emetics, and corresponding effects of Mental Emotions, and other relative considerations, and as acting through the medium of the nervous influence variously modified according to the nature of its exciting cause, p. 547–550, § 863 *d*; p. 631–632, § 892¾ *b*. Also, Mental Emotions, Disgust, Cathartics, Emetics, *Index II.*
the usage of reasoning from the results of experiments with remedies upon man in health to their effects upon morbid conditions must be included among the important obstacles in the

Remedies—*continued.*
way of philosophical as well as practical medicine on account of the vital changes in the diseased parts, and the alterative influences of these changes upon the susceptibilities of all parts (p. 535–539, § 847–850, and Law of Adaptation, *Index I.*; Diseases, Self-limited, second *subdivision*), and especially from similar experiments upon animals, who differ not only from man, but each species from others in their vital constitution, p. 3, § 2 *b*; p. 63, § 137 *d*; p. 65, § 143 *c*; p. 67, § 149–151; p. 68, § 152 *b*; p. 73, § 163; p. 122, § 240; p. 148, § 334; p. 430–433, § 675–676 *a*; p. 435, § 680; p. 456, § 698; p. 465–466, § 715; p. 482, § 744; p. 498, 784 *a*; p. 509, § 810; p. 530, § 837 *cc*–840; p. 535–539, § 847–850; p. 541–542, § 854 *bb*; p. 545, § 859 *a*, *b*; p. 548–549, § 863 *d*; p. 607–608, § 892 *a*, *b*; p. 612, § 892½ *a*; p. 623, § 892⅔ *c*; p. 676, § 904 *c*—and when injected into the circulation, they must of necessity give rise to some of the effects, among a greater variety, as when administered by the stomach, p. 529–533, § 836–841, though these may have been as much overrated as certain supposed effects of quinine, p. 603, § 892 *k*, and which is rendered the more probable by the statements of other distinguished observers as to the effects of morbific agents when injected into the circulation, p. 482, § 744; p. 527–528, § 830–831; p. 932, § 1088 *d*.
their operation by absorption, as generally interpreted, very embarassing to a distinguished advocate thereof on account of a perplexing difficulty offered by the portal vein, p. 527, § 829.
as disease consists of a succession of changeable pathological causes, whether it terminate favorably or fatally, remedies operate like morbific causes, and for other reasons assigned, but with the difference that the former are less profoundly morbific, and substitute pathological states that are readily capable of subsiding spontaneously through the inherent tendency of the properties of life to return to their natural states, and therefore by no possibility can they transmute the morbid into a healthy condition, which is alone the work of elaborate processes of organization—all of which are impossible problems for Chemistry and Physics, especially in connexion with the variety of means that will subdue a given form of disease, the necessity of accurate doses, and the importance and the ability of projecting a plan of treatment consisting of a variety of means to be applied in an exact consecutive order to fulfill the intention of introducing a succession of pathological changes of which each one is necessary to the next in order, from the abstraction of blood to the cathartic, then to the antimonial or mercurial alterative, then a blister, mayhap quinine, or arsenic, or guaiacum, or colchicum, or iodine, &c., and where there are but shades of difference in the morbid states—while, also, any given form of disease, such as intermittent fever, may be arrested by cinchona, or arsenic, or cobweb, or an emetic, or loss of blood, or a mental emotion, and syphilis by mercury, or iodine, or bromine, &c., each one a simple element, but having physical properties and chemical relations very widely different, and which may be just as consistently assumed to form salts with each other as that they will alike cure the same conditions of disease by chemical action upon the tissues, or upon the blood or miasms, and considering, too, that less than a grain of quinine or of arsenious acid will subdue an intermittent fever, or that quantity of the latter break up a chronic cutaneous disease over the whole surface of the body—but thus showing that the substitution of a large variety of pathological changes corresponding with the alterative virtues of the several remedies, respectively, is capable, each one, of placing the more profoundly morbid states in the way of spontaneous subsidence, so that, whether it be a simple intermittent fever or complicated with cutaneous eruptions, when the impression is made that will enable Nature to throw off the fever, the same artificial change may equally induce, upon the same recuperative principle, the disappearance of the chronic affection of the skin, p. 67, § 149–152; p. 87, § 177–182; p. 122, § 237–240; p. 147, § 330; p. 333, § 503; p. 417–418, § 650; p. 424, § 662; p. 426, § 666; p. 428, § 672; p. 430–433, § 675; p. 438, § 684, No. 9; p. 470–471, § 729–731; p. 473–474, § 733 *c*; p. 486, § 750 *b*; p. 487–488, § 756; p. 535–539, § 847–850; p. 541–545, § 854–860; p. 547–549, § 863 *d*; p. 551–554, § 867–871; p. 561–562, § 888 *a*–*d*; p. 596, § 892 *b*, *c*; p. 606, § 892 *p*; p. 637, § 892⅘ *d*, *e*; p. 648–649, § 893

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g; p. 661–670, § 894–902; p. 679–683, § 905 *a, b*; p. 696, § 926.
it follows, therefore, that one remedy prepares the way for another, and in a variety of respects, p. 367, § 556 *c*; p. 423, § 659; p. 424, § 662 *b*; p. 428, § 672; p. 545, § 859 *b*; p. 551–552, § 867–868; p. 554–556, § 892; p. 561, § 888; p. 595–600, § 892 *a–d*; p. 658, § 893 *p*; p. 664–665, § 900–901; p. 843, § 1058 *f*; p. 844–847, § 1058 *m–q*.
the Author anticipates an assumption, when the doctrine of the operation of remedial and morbific causes, physical and mental, through reflex and direct action of the nervous system, can no longer be resisted, that the nervous influence is the chemical agent which does the work, and answers that the obstacles will be in no respect removed, for, in this special respect, in carrying out the Chemical hypothesis, there should be no varieties in results corresponding to the nature of the remote exciting causes, but the nervous influence should always act in conformity with any special agent employed in the Laboratory, and therefore produce uniform phenomena, at least in any given part, as when an acid unites with an alkali, or platina predisposes oxygen to unite with hydrogen, while, on the contrary, the Author's doctrines conform to the very maxim of the Law—*qui facit per alium, facit per se.* As ABOVE.
their effects owing to the mutability of the properties of life, which is designed for useful purposes. See REMEDIAL ACTION; RECUPERATION, LAW OF, *Index II.*; VITAL PROPERTIES, *Index I.*
are abortive whenever the morbid changes transcend the recuperative law, p. 420, § 654 *a*; p. 552, § 868 *b*; p. 661, *mottoes*; p. 728, § 964 *c*. Also, RECUPERATION, LAW OF, *Index II.*; VITAL PROPERTIES, *Index I.*
the great law of recuperation demonstrable in the self-limited diseases, and in animals, p. 531, § 839; p. 544–545, § 858, 861; p. 551, § 863 *h*—and by the simple system of watching or expectant plan, p. 543, § 855–857; p. 558–559, § 877–881.
hence, in a general sense, the most important remedy in the treatment of diseases, acute and chronic, is a properly regulated diet—a limitation to farinaceous fluids in the early stages, at least, of the former, while in the latter, the circumstances of each case must determine the choice—there being ingrafted upon the constitution of the whole animal kingdom a principle, latent in health, but which enables them in disease to bear an abstinence that will alone surmount the most formidable conditions, but which would probably be often fatal in the natural state of the system—and in man the principle is the same as that which renders the most active remedies curative instead of morbific, p. 63, § 137 *b–e*; p. 67, § 149; p. 69, § 156 *b*; p. 538–540, § 847 *g*–848; p. 543, § 855–856; p. 551, § 863 *h*; p. 558–559, § 879–883 *b*; p. 600, § 892 *d*; p. 736, § 980. Also, ADAPTATION, LAW OF, *Index I.*; RECUPERATION, LAW OF, *Index II.*
by healing a primary disease which had given rise to sympathetic developments of disease in other parts, the sympathizing ones often recover not only as a consequence of the subsidence of the morbific reflex nervous influence, but the abatement of the primary affection may become also a source of salutary sympathetic influences upon the secondary developments; or, one disease supervening as a sympathetic result of another may be the means of reflecting, after the manner of counter-irritants, a salutary alterative reflex action upon the primary affection, p. 65–66, § 143 *c*; p. 67, § 148; p. 351–352, § 524 *c*; p. 360, § 528; p. 421–422, § 657; p. 506, § 804; p. 539, § 848; p. 570, § 889 *n*; p. 652–654, § 893 *n*; p. 679–681, § 905 *a, b*; p. 592, § 891½ *k*; p. 666, § 902 *b*. METASTASIS, *Ind. II.*
often bring organs not affected by disease, through reflex nervous action, particularly the skin, into a condition which becomes the exciting cause of other reflex influences that fall upon diseased organs with a salutary effect. See this *subdivision* under REMEDIAL ACTION, *Index II.*
operate progressively or abruptly, according to the intervals of application, when, in the former case, the reflex nervous influence is maintained in unceasing action by a succession of different remedies, or doses of the same remedy, at short intervals, and even in the latter case, as after the administration of an efficient emetic or cathartic, the reflex influence is kept up by the impression made on the gastro-intestinal mucous tissue with alterative effect for some hours after their more manifest effects are over, and the same principle holds in

Remedies—*continued.*
respect to mental emotions—and farther, that remedial influences are exerted and maintained by the smallest doses of the remedies designated by the Author as Alteratives, is evident not only from the abatement of symptoms, but from the vomiting which will often follow after the first few doses of an eighth of a grain of tartarized antimony or a grain of ipecacuanha—and so of mercury, arsenic, iodine, quinine, &c., p. 111, § 233½, 233¾; p. 285–286, § 455 *d*; p. 333, § 503–506; p. 339, § 514 *g*, *h*; p. 344–345, § 516 *d*, No. 6; p. 365, § 551; p. 366, § 556; p. 416–417, § 469 *c*; p. 420–424, § 654–661; p. 532, § 841; p. 547, § 863 *d*; p. 551, § 867; p. 568–569, § 889 *m–mm*; p. 592–593, § 891½ *k*; p. 599–600, § 892 *d*; p. 646–649, § 893 *c–h*; p. 661–663, § 894–896; p. 668–670, § 902 *g–m*; p. 675–676, § 904 *b*; p. 679–681, § 905 *a*. Also, Alteratives, Sphincter Muscles, Roosting, Miasm; Hydrophobia, Virus of; Mental Emotions, *Index II.*

a single remedy may be adapted to a large variety of pathological conditions, and these may exist simultaneously in different parts as the sympathetic results of a single disturbance, and associated also with idiopathic fever, and the remedy may be adequate to the removal of all the functional lesions, or preparatory of the whole to the favorable action of another remedy of opposite virtues, and upon which the cure may ultimately depend—thus showing, also, by the variety of means which individually may arrest very complex states of disease, that our doctrine of alterative influence of reflex action of the nervous system, modified according to the nature of the remedy, and the harmonizing influences of coexisting diseases upon each other through the medium of the same reflex action as brought into reciprocal operation by the several affected parts, and the substitution of pathological states with a disposition to subside spontaneously, can alone explain the phenomena with any consistency with the immediate facts and with those which relate to Chemistry and Physics, p. 63, § 137 *c–e*; p. 65–67, § 143 *b*, *c*–148–151; p. 298, § 476½ *h*; p. 304, § 481 *g*; p. 309–310, § 484 *b*, No. 5; p. 337, § 514 *b*, *c*; p. 361, § 529 *b*; p. 367, § 557 *a*, *b*; p. 426, § 666; p. 430–433, § 675; p. 465–466, § 715; p. 479–480, § 741 *a*, *b*; p. 498, § 784 *b*; p. 509, § 811; p. 535–539, § 847–848; p. 542–543, § 854 *f*, and *references* there; p. 552–553, § 870 *a*, *aa*; p. 597–599, § 892 *c*, *d*; p. 608–610, § 892¾ *c*, *d*; p. 662–664, § 895–900; p. 731–732, § 970 *c*; p. 739–740, § 986–987. Also, Adaptation, Law of, *Index I.*; Diseases, Self-Limited, *Index II.*

distinction among various remedies that may produce some common result, and that result apt to be most relied upon as a remedial test, yet shown to be insignificant, and that the virtues of remedies must be tried by different considerations, p. 547–550, § 863 *d*; p. 566, § 889 *i*; p. 571, § 890 *b*; p. 572–573, § 890 *d*; p. 576–577, § 890 *l–o*; p. 587, § 890½ *b*; p. 590–593, § 891½ *a–k*; p. 628–633, § 892¾ *q*–892¾ *d*; p. 636–640, § 892¾ *d–f*; p. 669, § 902 *h*; p. 687–688, § 905½ *c*; p. 857, § 1063 *b*. Also, Sudorifics, *Index I.*

their application in acute and chronic diseases subject to great differences in the details, the latter of which fall under what the Author designates as Vital Habit. See Pathology, and the various practical Articles, *Index II.*

variously influenced by Mental Emotions, p. 865–868, § 1067. Also, Mental Emotions, the individual *Passions*, Remedial Action, subdivision *Mental Emotions*, *Index II.*

abuse of,—see p 988, 2d. *subdivision.*

the Hippocratic rule, that "severe diseases require severe remedies," to be received in a broad, not universal sense, and exceptions stated, p. 723–724, § 960 *h*, and *references* there.

contrast between Chemistry and Vital Solidism as practically applied to Therapeutics, p. 147, § 330; p. 170–173, Nos. 40–46; p. 176–178, § 350¾ *a–f*; p. 514–415, § 819; p. 517–518, § 821 *c*, 822; p. 540, § 851.

Remedies, Endermic,

operating with purely local effect, their action is doubtless greatly limited to the organic constitution of the skin, with that participation of the nerves, however, that necessarily arises from their incorporation with the other tissues; but any resulting influences extending beyond the skin are dependent upon reflex action of the nervous system, p. 475, § 733 *h*; p. 483–484, § 746 *c*. § 826 *c*. Skin, Cold, Counter-Irritants, Plasters, Seton, Nervous Power, *subdivision* p. 1024, *Index II.*; Vital Properties, Irritability, Nervous Power, *Index I.* Also, § 1088 *b*.

Remote Causes of Disease. See Causes, Morbific, *Index II.*

Reparation,
a law prevailing universally in organic beings—analogies between its modifications in Animals and Plants under various aspects—shown to be the result of inflammation in the union of wounds by the first intention, and that the nervous system contributes one of the elements of its distinctions as presented by Animals and Plants, p. 474–475, § 733 *f–i*. Also, Vital Properties, Organic Life, Plants, *Index I.*

Respiration, continued from *Index I.*,
general anatomical and physiological exposition of, in respect to the reflex action of the nervous system by which it is determined, and associated with the analogous causation of vomiting as occasioned by emetics, diseases, mental emotions, &c., and the distinctions attending the effects of the latter from those of the simple phenomenon of respiration, and the distinctions between the complex and profound alterative influences of the reflex action as determined by emetics of active virtues and the slighter ones of other causes, and carried to the interpretation of the modus operandi of all morbific and remedial agents, physical and mental, through alterative influences of reflex or direct action of the nervous system beyond the direct local action of physical agents, p. 110, § 232; p. 111, § 233¾; p. 290, § 462; p. 296, § 476 *c*; p. 302, § 481 *b*; p. 323–330, § 500 *c-nn*; p. 333–335, § 503–511; p. 336–338, § 514 *b–d*; p. 413, § 639 *a*; p. 592–593, § 891½ *k*; p. 666–670, § 902 *b–m*; p. 671, § 903. Also, Mental Emotions, Disgust, Reflex Action, Remedial Action, *Index II.*; Will, Nervous Power, *Index I. and II.*
various modifications of, as in sneezing, coughing, yawning, laughing, asthma, hiccough, &c., employed for the foregoing purposes, p. 327, § 500 *i*; p. 338, § 514 *d*; p. 340, § 514 *k, l*; p. 886–890, § 1077. Also, Hiccough, Asthma, Yawning, &c., *Index II.*
should be considered, also, in connexion with the universal fact that all the muscles in organic and animal life are greatly or altogether dependent for their movements upon the stimulus of the nervous influence either reflex or direct, and that this consideration, as it respects the action of the heart and arteries in their ordinary motions, and as they are conspicuously affected through the nervous influence by mental emotions, food, exercise, &c., and by most diseases, renders it manifest that remedial and morbific agents, taken into the stomach, must, by their action upon that organ, transmit influences to the nervous centres that will be reflected upon these exquisitely susceptible organs with a more profound effect, especially upon that terminating series of vessels which are so sensitive to all mental emotions, and which are the essential instruments of all healthy and morbid processes. See Reflex Action, Remedies; Causes, Morbific; Heart, Cathartics, Counter-Irritants, Skin, Cold, Bloodletting, Inflammation, Whooping-Cough, Phthisis, Exercise, Mental Emotions, Fear, Jealousy, Shame, Food, Vessels, &c., *Index II.*
the coincidences between voluntary and involuntary, employed in demonstrating the action of the Will and Mental Emotions through the direct propagation of the nervous influence upon the voluntary and involuntary organs. See *references under first subdivision*, and Sphincter Muscles, Roosting, *Index II.*
employed in demonstrating the substantive existence and self-acting nature of the Soul and Instinctive Principle, p. 875–877, § 1072 *a*.

Revulsion. See Metastasis, *Index II.*

Rheumatism,
treatment of, by bloodletting, tartarized antimony, &c., p. 720, § 960 *a*; p. 733, § 974 *a*; p. 845–846, § 1058 *n*.
considered in its relations to the doctrines of *metastasis* and *repulsion*, p. 354, § 525 *c*; p. 652–656, § 893 *n*. Also, Metastasis, *Index II.*
as affecting the heart in articular conditions, is not owing to abstraction of blood, but to the same reflex nervous action which is at play among the joints, and calls for farther loss of blood, p. 656, § 893 *n*. Also, p. 353–354, § 525 *b, c*.

Rhubarb,
its variety of effects, cathartic, astringent, tonic, and stimulant, according to the precise conditions of disease and its doses, contradict the chemical hypothesis of its modus operandi and illustrate its impractical nature, and how all things concur together in demonstrating those effects through variously modified influences of the nervous power, p. 554–556, § 872 *a*; p. 565–566, § 889 *g*; p. 571, § 890 *b*; p. 575–576, § 890 *i–l*; p. 578, § 890 *p*; p. 581, § 890½ *e*; p. 661–663, § 894

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Roosting, and the sleeping of quadrupeds in an erect posture,
and occasional instances of man's—when the Will determines, through the nervous influence, a rigid state of the voluntary muscles which reacts upon the nervous centres, and thus maintains an unceasing reflex action that corresponds exactly with the effect of the voluntary act (and as seen also in voluntary and involuntary respiration and contraction of the sphincter muscles), and holds them in the same rigid contraction as instituted by the Will, and which is the cause of the reflex development, being a rare example of reflex nervous action arising from the Will—employed in demonstrating the substantive existence and self-acting nature of the Soul and Principle of Instinct, and for illustrating the modus operandi of remedial and morbific agents, and of Mental Emotions through alterative influences of the nervous power, § 500 *dd*, 514, 1077. Also, Mental Emotions, *Index II.*; Will, *Index I. and II.*

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Saline Cathartics. See Cathartics, Saline, *Index II.*
Salivary Glands,
pour out the saliva under the exciting influence of nervous action as developed by the mind, whether the remote cause be the odor of food, or its expectation, &c., p. 335, § 512 *a*; p. 866, § 1067; p. 877, § 1072 *b*—being exactly coincident with the flow of urine and sweat as occasioned by Fear, p. 630–632, § 892¾ *b*, and weeping by Grief, p. 880, § 1074—and with the increased production of saliva and bile as determined by the presence of food in the stomach, through
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reflex action of the nervous system, p. 335–336, § 512 *a*, *b*; p. 339–340, § 514 *h*—and with that of urine as the result of cold applied to the surface, and of lactation through the same causation, p. 230–232, § 422 *b*–424—and employed along with other analogies to interpret the modus operandi of morbific and remedial agents, physical and mental, through alterative influences of the same nervous action, *ibid.* Also, Secretion and Excretion, Urine, Milk, Bile, Weeping, Parturition, Odors, Fear, Jealousy, Kidney, Skin, Food, &c., *Index II.*; Sudorifics, *Index I.*
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Scurvy,
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Sea-Sickness
depends in part upon mental emotions, and partly upon unaccustomed movements of the body, through complex influences of direct and reflex action of the nervous system upon the stomach, but which soon subside under the law of Habit, and may be restrained by the Will through a counteracting development of the nervous power—employed in demonstrating the substantive existence and self-acting nature of the Soul, and is not less applicable to the modus operandi of morbific and remedial agents of a material nature, § 1067 *aa*; § 1077. Also, Exercise, Phthisis, Whooping-Cough, Intestine, Mental Emotions, Thunder, Disgust, Fear, Joy and Anger, Reflex Action, *Index II.*; Will, *Index I. and II.*; *Medical and Physiological Commentaries*, vol. i., p. 569–574.
Secreted Products
have no existence in the blood nor in sap, and therefore are not "strained off," p. 24, §,42; p. 219–227, § 408–411; p. 478–479, § 740–741; p. 484, § 748; p. 780, § 1029; p. 783, § 1031 *b*; p. 790, § 1032 *b*; p. 791, § 1032 *c*; p. 800–801, § 1035.
the advocates of remedial action by absorption express "great astonishment that the bile is not more frequently affected by the various medicinal agents put into the stomach"—and why not also the chyle—why no absorption of the bile, of intestinal acids, and other offensive things that often abound in the intestinal canal—why no manifestation of the "medicinal agents" by the highly irritable heart? p. 527, § 829. Also, p. 129–131, § 277–284; p. 132–134, § 289–295; and Lacteals, Lymphatics, *Index II.*; Veins, *Index I. and II.*
Secretion and Excretion,
analogous functions, the latter being properly comprehended in the former, but having certain differences in final causes and composition, p. 217, § 402; p. 227–228, § 412–417.
influenced by direct and reflex action of the nervous system upon their immediate instruments, when they will be simply increased or diminished, or, what is greatly more important, variously altered, or new ones generated, according to the manner in which the nervous power may be modified by the causes which bring it into preternatural operation, both physical and
Secretion and Excretion—*continued.*
mental, p. 105, § 220 *b*; p. 107–110, § 226–232; p. 193, § 356 *a*; p. 215, § 395; p. 230–232, § 422 *b*–424; p. 249, § 441 *c*; p. 253, § 441 *d*; p. 262–265, § 446 *a*–447 *a*; p. 262–265, § 446 *a*–447 *b*; p. 285–286, § 455 *d*–456 *b*; p. 289, § 461; p. 310, § 485; p. 313–314, § 488–489; p. 317, § 493 *a*; p. 325–326, § 500 *ee*; p. 335–336, § 512 *a*; p. 339, § 514 *h*; p. 341–342, § 514½ *b*; p. 344, § 516 *d*, No. 6; p. 348, § 516 *d*, No. 13; p. 350–351, § 524, No. 1; p. 355, § 526 *a*; p. 430–433, § 675, 676 *a*; p. 450–452, § 691–693; p. 478–479, § 740–741 *b*; p. 483–484, § 746 *c*; p. 546–549, § 862–863; p. 563, § 889 *a*; p. 565, § 889 *f, g*; p. 630–632, § 892⅔ *b, c*; p. 634, § 892⅘ *a, b*; p. 637, § 892⅘ *d*; p. 662, § 896; p. 666–672, § 902 *b*–904 *a*; p. 704, § 943 *a, b*; p. 709, § 951 *c*; p. 710–711, 952 *b–g*; p. 866–868, § 1067. Also, Bile, Milk, Lactation, Parturition, Mental Emotions, Fear, Jealousy, Food, Skin, Cold, Kidney, *Index II.*; Organic Heat, *Index I.*
the fluid products of glandular organs, sweat, gastric juice, &c., and all the solids, on common ground as it respects their dependence upon organic actions and their relations to the nervous system, though in the normal state the fluids manifest far greater influences of the nervous power than the composition of the solids, and the glandular fluids more so than the membranous; *ut supra*, and Organic Compounds, Vital Properties, Organic Life, *Index I.*
the apparently endless variety of organic fluids as well as solids in plants and animals, and each one forever the same in any given part in its perfect state, and mostly composed of four elements, their ternary or quaternary combinations, ratios and diversities in their modes of union, their dependence in animals for their perfected condition upon modifying influences of the nervous system, while they have no such tributary aid in plants, and their natural and morbid fluctuations in animals under the influence of direct and reflex action of the nervous system as brought into effect by mental emotions or physical agents, and according to their precise nature, contradistinguish the laws of organic from those of inorganic bodies—and a fundamental distinction drawn between what belongs to organic life and what is referable to its influences by the nervous system, p. 21, § 22; p. 23–26, § 37–48; p. 27–28, § 52–53;

Secretion and Excretion—*continued.*
p. 30, § 58; p. 193, § 356 *a*; p. 220–227, § 409 *b*–411; p. 230–232, § 422 *b*–424; p. 262–263, § 446 *a*; p. 289, § 461; p. 313–315, § 488–489; p. 317–318, § 493; p. 335–336, § 512 *a, b*; p. 355, § 526 *a*; p. 483–484, § 746 *c*; p. 547–548, § 863 *d*; p. 563–564, § 889 *a*; p. 630–632, § 892½ *b, c*; p. 668–669, § 902 *g*; p. 704, § 943 *a*; p. 804–805, § 1040; p. 866–867, § 1067 *a*; § 221½, 399, 456 *a*, 478 *b*.
by now taking in connexion what the Author has said under the sections in the two preceding subdivisions of the influences of the reflex action of the nervous system upon the secreted fluids, there may be found, at p. 478–480, § 740–741 (where the Author presents an example, for illustration, from the humoral pathologist), the whole philosophy distinctly and briefly presented relative to the part which the nervous influence takes in organic processes, the products being generated by the organic mechanism through its own inherent properties, p. 55, § 113–117; p. 58–59, § 129 *c–i*; while the nervous influence, in its morbific aspect, and whether excited by physical or mental causes, so modifies their condition that they elaborate morbid instead of natural products; and, turning to the example of the *Seton* at p. 679–681, § 905 *a*, there will be found, in an equally succinct manner, the whole philosophy of the alterative influence of reflex action of the nervous system as the medium through which all the modifications of secreted products, as set forth under the sections embraced in the foregoing subdivisions, are brought about, and as exemplifying all that is ever concerned in the modus operandi of remedial and morbific causes, upon parts beyond the seat of their direct operation—while, also, even animal heat is on the same common ground with other secreted products, and its generation, therefore, is alike influenced by reflex and direct action of the nervous system. See, also, Nervous System, *Index II.*, p. 1029, subdivision upon *Animal Heat.*
considered by the Author as "fully settled by experiments" made by A. P. W. Philip, that "the power of secretion is independent of, though influenced by the nervous system," as appears in his Reports of the same in *London Philosophical Transactions* for 1815 and 1817, and to which there are summary references at p. 314–315, § 489; p. 317–318, § 493 *a–d*—
Secretion and Excretion—*continued.*
and, therefore, long antecedently to the suggestions upon the same subject by Henle, Donders, Ludwig, &c., while, also, Bichat had arrived at the same opinion without the aid of experiment, p. 270, § 447 *d*.
uses in diseases of fluid products, being different according to the nature of each, p. 231, § 422 *c*; p. 232–234, § 427–428; p. 450–451, § 691, 692; p. 471, § 732 *b*; p. 473–474, § 733 *e*; p. 546–551, § 862–864; p. 637, § 892⅘ *d*; p. 639, § 892⅘ *g*; p. 647, § 893 *f*. Also, Sweat, Pus, *Index II.*
Sedatives—continued from *Index I.*,
definition of, p. 828, § 1057 *a*—and distribution into five groups, p. 830, § 1057 *c*.
the term does not imply their most essential action, which is variously *alterative* through the medium of reflex nervous influence, and according to the nature of the Sedative; and, although it is the change in *kind* which each one institutes in the organic properties that forms their characteristic distinction, the only two, loss of blood and tartarized antimony, of much importance as curative remedies, and these in all other respects totally unlike, will, nevertheless, effect such alterations in morbid states as render them the most universal means of subduing inflammations and fevers—being also sufficiently conclusive that the philosophy of their operation has not the most remote alliance to the rigorous laws of Chemistry, p. 829–832, § 1057 *a–f*; p. 838, § 1057½. Also, p. 664, § 900; p. 681–683, § 905 *b*. Remedial Action, Stomach, *Index II.*
many of them, especially the Narcotics, Hydrocyanic Acid, Aconite, Strychnia, may determine the nervous influence with great suddenness and violence upon the organic constitution of the brain as upon other parts, p. 298, § 476½ *h*; p. 300–301, § 479; p. 320, § 494 *dd*; p. 324, § 500 *c*; p. 334, § 509; p. 520–521, § 826 *d*; p. 523–524, § 827 *d*; p. 592–593, § 891½ *k*; p. 671–672, § 904 *a, b*; p. 704, § 943 *a, b*; p. 706, § 946; p. 831–832, § 1057 *f*; p. 838, § 1057½. Also, Stomach, Blows upon, *Index II.*
Aconite, in relieving neuralgia when applied to the skin, illustrates the alterative influence of reflex nervous action upon particular nerves, p. 838, § 1057½. Also, Sympathy, Contiguous; Counter-Irritants, Plasters, &c., *Index II.*
other examples of the external applica-

Sedatives—*continued.*
tion of Belladonna, Hyoscyamus, and "an imponderable quantity of Atropia," and of the bite of venomous Reptiles, and of Opium, and Hydrocyanic Acid, internally, where it is evident that their effects were determined by alterative influence of reflex nervous action, p. 319, § 494 *b–dd*; p. 525–526, § 828 *b, c*; p. 672–674, § 904 *b*.
may act as such only in special conditions of disease, p. 829–830, § 1057 *a, b*.
varieties in effects of Cold, p. 832, § 1057 *g*. Also, Cold, Skin, *Index II.*
comparative effects of Bloodletting, Hydrocyanic Acid, and Tartarized Antimony, p. 831, § 1057 *e*.
Cotton-wool and Castor Oil, as possessing sedative virtues, p. 833–835, § 1057 *k, l*.
examples of, contrasted with Stimulants, p. 829, § 1057 *a*.
may produce inflammation, p. 480–481, § 743; p. 502, § 817; p. 523, § 827; p. 584, § 891 *d*; p. 708, § 950; p. 733, § 874 *b*; p. 773–775, § 1024; p. 829, § 1057 *a*.
Self-Limited Diseases. See Diseases, Self-Limited, *Index II.*
Senna,
its therapeutical and morbific effects, the latter preponderating, p. 858, § 1064.
Senses,
weariness of, said to be similar to "chemical changes on an iodized plate"—supplying an example of the fallacies of reasoning from the phenomena of inorganic bodies and artificial contrivances to identify their laws with those of living beings, p. 797–798, § 1034. Also, p. 132–133, § 289–291; p. 167, No. 29; p. 168, No. 31; p. 172–173, No. 44, 45; p. 175–176, § 350½ *n–p*; p. 177–178, § 850⅔ *f*; p. 238, § 438 *b, c*; p. 517, § 721 *c*; p. 528, § 832–835.
Sensibility, continued from *Index I.*,
important to distinguish it from Irritability, not only as a property peculiar to animal life, but as the medium of transmitted impressions in the function of reflex action of the nervous system, p. 89, § 188 *a*, &c.; p. 101–102, § 201–202; p. 282–283, § 451 *d–f*; p. 671, § 903.
some new observations as to its relation to the posterior roots of spinal nerves, p. 802, § 1037 *b*.
sympathetic and other modifications farther distinguished by Brown-Séquard's experiments, p. 802, § 1037 *b*. Also, p. 216, § 399; p. 313, § 487 *gg*.
Serous Tissue,
treatment of its inflammations, p. 727, § 960 *f*; p. 750, § 995; p. 756–758, § 1005 *b–h*; p. 847, § 1058 *r*.
Serpents, Virus of,
experiments by several hands proving that it does not operate by absorption, but, like the hydrophobic virus, by morbific influence of reflex action of the nervous system instituted by the bitten part, p. 319, § 494 *b–dd*; p. **1146**; p. 525–526, § 828 *a–d*. Also, Hydrophobia, Virus of, *Index II.*
Seton,
its modus operandi both locally and through alterative influence of reflex action of the nervous system, exemplifying the whole philosophy that is ever concerned in the operation of remedial and morbific agents, p. 679–681, § 905 *a*—originally set forth in Essay on the "Modus Operandi of Remedies" (1842).
Shame
doubtless awakens the consciousness of an internal monitor distinct from the corporeal fabric—but how does it betray itself in the crimsoned cheeks, or, if blended with a little Fear, in the trembling muscles, the drops of sweat, and the flow of urine, unless through that amazing principle, the nervous influence, which may strike us dead in an instant when Joy and Anger make their sudden and violent demonstrations, or as blows upon the epigastric region, and surgical operations, and the bite of venomous serpents, and hydrocyanic acid, and the respiration of chloroform, will do the same—and thus, also, as unmingled or compounded with other emotions, Shame exemplifies the manner in which remedial and morbific agents of a physical nature, and according to their simplicity or complexity and the nature of each, will institute corresponding influences of reflex nervous action—or turning to Fear alone, there may be seen in its displays of the nervous influence a near coincidence with that universal alterative impression which a single morbific or remedial agent may exert, as witnessed in the production of fever, and in its cure by loss of blood or an emetic, or, to complete the coincidence, by a mental emotion, p. 95, § 118½ *d*; p. 107–111, § 227–233¾; p. 245, § 440 *e*, No. 14; p. 324, § 500 *c*; p. 327–328, § 500 *j, k*; p. 332, § 501 *c*; p. 333, § 503; p. 339–341, § 514 *g–m*; p. 631–632, § 892¾ *b*; p. 661–663, § 894–896; p. 665–670, § 901–902; p.

Shame—*continued.*
679–681, § 905 *a*; p. 704, § 943 *a, b*; p. 706–707, § 947; p. 709, § 951 *b–d*; p. 879–882, § 1074–1075; p. 891, § 1077; p. 901, § 1078 *l*. Also, Remedial Action, Mental Emotions, Joy and Anger, Fear, Disgust, Love, Grief, Hope, Thunder, &c., *Index II.*; Nervous Power, *Index I. and II.*

Shower-Bath,
its curative or morbific effects upon internal organs exerted through alterative influences of reflex nervous action, after the manner of cold air in starting the secretion of urine, or in the production or cure of disease, of counter-irritants, &c.—employed to illustrate the modus operandi of all other remedial and morbific agents upon parts beyond the seat of their direct operation, and to show how readily the nervous influence is modified in its nature by its exciting causes, and how diversely it will affect organs according to their existing condition, the nature of tissues, &c., p. 832–833, § 1057 *g*. Also, p. 59, § 129 *g–i*; p. 61, § 132–133; p. 63–67, § 137 *b*–151. Skin, Cold, Exercise, Friction, Amenorrhœa, *Index II.*

Sigmond,
his observations upon certain special effects of Narcotics, p. 673, 674, § 904 *b*. Also, Opium, Sedatives (*Aconite*), *Index II.*
his opinion of the Anatomical School of Medicine, p. 603–604, § 892 *k*.

Silver, Nitrate of,
best local remedy for leucorrhœa, p. 576, § 890 *m*; p. 688, § 905½ *c*.
absorbed in the condition of an inert muriate, or would otherwise be converted into an inert substance on its passage to the blood—introduced for the purpose of showing that Astringents and other remedies operate upon parts beyond the seat of their direct action through alterative influence of reflex nervous action, p. 530, § 873 *e*; p. 533, § 842; p. 577, § 890 *o*.

Simon,
his vital exposition of fibrin, p. 800, § 1035. Also, Müller's and Hunter's, p. 24, § 42.

Skin,
exquisitely susceptible in *sympathetic* sensibility (p. 101–102, § 201–202; p 282–283, § 451 *d–f*; p. 695, § 924) to impressions from particular causes that produce no apparent disturbance of its organic condition, but which are capable of exciting a disturbing reflex action of the nervous system, as witnessed in the suddenly increased secretion of urine on the contact of cold air, and the production of internal inflammations from the same cause, or, at other times, in the invigorating and curative influences of cold either through the medium of air or the shower-bath, and as seen in rousing the heart in syncope, and in the counteracting effect of the cold dash in cases of narcotic poisoning, &c., and in the effects of the hot bath, medicated baths, and of friction, upon internal organs—and this associated with the morbific action of miasms and other analogous causes, and with the analogies supplied by certain special effects of narcotics, plasters, &c., where absorption cannot be surmised, and with the more strongly pronounced analogies derived from counter-irritants, setons, &c., and uniting with the whole many natural functions in which the reflex nervous action is the immediate exciting cause, as respiration, the motions of the heart, of the intestine, of the iris, deglutition, &c., and taking along the important part which the nervous system contributes in the development of the body from Infancy to Adult age, in pregnancy, parturition, lactation, &c., and many other corresponding facts which the Author brings to sustain his conclusions in respect to the Skin, he recurs to the evidence supplied by that organ of its exquisite sensitiveness to certain natural stimuli and morbific agents, and the unequivocal dependence of their remote effects upon the nervous system, and endeavors to show that all other agents of less obvious modes of action as mercurial ointment, or any of the soluble preparations of mercury, &c., when applied to the skin, affect internal parts through the medium of alterative influences of reflex action of the nervous system, and to show, also, by the collective force of all the foregoing analogies, as well as by the obvious mode of action through the nervous system of many things applied to the alimentary mucous tissue, such as emetics, &c., that all remedial and morbific causes exert their effects through that same medium upon parts beyond the seat of their direct operation, p. 61, § 133; p. 66–67, § 148; p. 107–112, § 227–234; p. 230–232, § 422–427; p. 245, § 440 *e*; p. 253, § 441 *d*; p. 308–310, § 484–485; p. 312, § 487 *g*; p. 319–320, §

Skin—*continued.*
494 *b–dd*; p. 321, § 497; p. 323–324, § 499–500 *c*; p. 327, § 500 *i*; p. 331–332, § 500 *o*–501 *c*; p. 333, § 503; p. 335–336, § 512; p. 338, § 514 *d*; p. 339–341, § 514 *g–m*; p. 343, § 516 *d*, No. 4; p. 346, § 516 *d*, No. 9; p. 348, § 516 *d*, No. 13; p. 349–350, § 520–523; p. 351, § 524 *a*, No. 1; p. 352, § 524 *c*; p. 353, § 524 *d*, No. 4–7; p. 355, § 526 *a*; p. 359–360, § 527 *a–d*; p. 416–417, § 649 *c*, *d*; p. 421–423, § 657–658; p. 424, § 662 *a*; p. 430, § 674 *d*; p. 468, § 722 *b*; p. 520–521, § 826 *e*; p. 523–524, § 827 *c–e*; p. 525–527, § 828 *a–d*; p. 532, § 841; p. 592–593, § 891½ *k*; p 631–632, § 892¾ *b*, *c*; p. 634, § 892⅘ *b*; p. 661–663, § 894–896; p. 665–676, § 902–904; p. 679–681, § 905 *a*; p. 705, § 945; p. 803, § 1038; p. 832, § 1057 *g*; p. 838, § 1057½; p. 880, § 1074, p. 642–644, § 893 *a–c*; § 956, 1088 *b*.
Secretion and Excretion, Sweat, Bile, Salivary Glands, Cold, Friction, Exercise, Opium, Mental Emotions, Fear, Jealousy, Pregnancy, Parturition, Organs of Generation, Stomach; Antimony, Tartarized; Counter-Irritants, Plasters, Predisposition, Pathological Cause, *Index II.*; Youth, *Index I. and II.*; Sudorifics, *Index I.*
it has never been shown, however much assumed, that the human Skin will absorb extraneous substances, not even water, as Magendie decides, and the experiments relative to opium, the wourari poison, the virus of serpents, hydrocyanic acid, &c., go to our present purpose; and this failure of experiments to prove absorption is farther shown by a forced analogy drawn from the supposed absorption of water by the Skin of Lizards; for, however the general analogies obtain in respect to great fundamental laws, they are quite liable to fail as regards certain special functions, and it would be an equal ground of reasoning with the foregoing to the Skin of man from animals that respire by that organ, or others by whom it is periodically shed, or, in other respects, from the regeneration of the Lizard's tail, &c., p. 175–176, § 350½ *n–p*; p. 306–310, § 483 *b–484*; p. 474–475, § 733 *f–i*; p. 520, § 826 *b–d*; p. 522–523, § 827 *b*, *c*; p. 530–531, § 837 *b–cc*; p. 827, § 1055; p. 930, § 1088 *b*.
the effects upon, by narcotization, and of acetic acid applied to the mouth and skin of eviscerated frogs, employed in interpreting the operation of remedies upon internal parts when
Skin—*continued.*
applied to the skin, through alterative influences of reflex nervous action. See Volkman, *Index II.*
some parts of, more susceptible of those impressions which occasion morbific influences of reflex action of the nervous system than other parts, p. 61–62, § 133–136; p. 415–416, § 649 *b*; p. 695, § 924, also Amenorrhœa, Leeching, *Index II.*—which reflects light upon Brown-Séquard's observations upon epileptiform convulsions, as produced by irritation of particular parts of the skin, p. 802, § 1037 *a*.
its eruptive diseases often occasioned by a morbific reflex action of the nervous system instituted by disorders of the alimentary canal, as manifestly the case after a debauch, and as seen, also, in the immediate subsidence of the cutaneous affection under the influence of an emetic or cathartic, which not only arrest the morbific cause, but determine a curative reflex action; and which serves as an index to the philosophy of the origin of numerous chronic eruptions, and of their cure by gradually alterative remedies operating through the same reflex nervous influence—or, again, a supervening eruptive disease may react upon and relieve the internal affection; and when we associate with the foregoing the heterogeneous variety of things that will alike cure the same chronic eruptions, whether internally or externally applied (even more various in their physical properties than the remedies for intermittents), and other analogous facts which meet our attention on every hand, the philosophy of Vital Solidism, wielding the magic power of the nervous system, falls with a crushing weight upon the factitious analogies borrowed from the precise laws of the inorganic world, p. 352, § 524 *c*; p. 359, § 527 *a*, *b*; p. 669–671, § 902 *i*, *m*; p. 673, § 904 *b*, also, Opium, Humoral Pathology, Remedial Action, *Index II.*—and the constitutional effects of small-pox, measles, and scarlatina probably depend upon a morbific reflex nervous influence instituted by the alimentary mucous tissue, as denoted, also, by the primary appearance of the eruption in the fauces—excepting as inoculated small-pox would involve a primary reflected influence of the nervous power upon the mucous tissue (instituted by the artificial pustule), and thence a reflected action upon the skin as the exciting cause of the general erup-

Skin—*continued.*
tion, p. 359, § 527 *a*, *b*. Also, Diseases, Self-Limited; Small-Pox; Hydrophobia, Virus of; Predisposition, *Index II.*; and *Medical and Physiological Commentaries*, vol. i., p. 494–513; p. 569–574.
Liebig's philosophy of its supposed agency in the circulation, p. 823, § 1055

Small-pox,
Author's theory of the primary locality of the disease, and of its propagation to other organs, analogous to that of hydrophobia, miasmatic diseases, &c., though in a more determined manner, as set forth under Article Skin, *Index II.*; p. 59, § 129 *h*; p. 65, § 143 *c*; p. 66–67, § 148; p. 333–334, § 502–506; p. 348, § 516 *d*, No. 13, 518 *a*, *b*; p. 351–352, § 524 *c*; p. 359, § 527 *b*; p. 360, § 527 *d*; p. 364, § 545; p. 368–369, § 559–563; p. 416–417, § 649 *c*, 650; p. 420–423, § 654–660; p. 426, § 666; p. 429–430, § 674 *d*; p. 465, § 714; p. 522–523, § 827 *b*, *d*; p. 539, § 847 *h*–848; p. 546, § 862; p. 553, § 870 *aa*; p. 670–671, § 902 *m*; p. 862–864, § 1066. Also, Hydrophobia, Virus of; Serpents, Virus of; Predisposition, Miasm, Whooping-Cough, Phthisis, *Index II.*
chemical theory of, p. 172, § 350, No. 45.
essentially the same as the Vaccine disease—extinguishes the susceptibility of the system to a second attack, upon the same principle as involved in acclimation—distinction in time of predisposition between natural and inoculated—has also the peculiarities of other self-limited diseases in being contagious without contact, and in having a definite course of rise and decline, and, like the others, illustrates by its remote cause the law of contagion, p. 364, § 543–548; p. 365, § 551; p. 366, § 554; p. 419–420, § 653; p. 421, § 654 *b*; p. 425, § 664; p. 488, § 756 *a*; p. 544–546, § 858, 861. Also, Diseases, Self-Limited; Acclimation, Miasm, Contagion, *Index II.*
notwithstanding, however, the remote cause carries with it its own curative virtue, and the disease in ordinary conditions admits of no active treatment, should inflammation of important organs supervene, they become the means of impressing upon the general malady, through an alterative influence of reflex nervous action, a modified condition, which enables the system to bear all the vigorous treatment demanded by the same inflammation when occurring independently—and so of other self-limited diseases, p. 65, § 143 *c*, and *references* there; p. 536–539, § 847–848; p. 542–543, § 854 *c–f*; p. 544–545, § 858; p. 553, § 870 *aa*; p. 665, § 901; p. 722–724, § 960 *h*; p. 730, § 969 *a*; p. 732, § 970 *c*; p. 733–734, § 973–975.
like measles, scarlatina, cholera, dysentery, &c., is liable to be rendered more prevalent and malignant than at other times through antecedent influences of common miasmatic causes, when, also, its character may be so modified as to render unusual means of treatment useful or necessary, as sometimes Cinchona; and hence the importance of looking well at any subordinate predisposing causes in all grave forms of disease, p. 418, § 652 *b*; p. 544–545, § 858; p. 553, § 870 *aa*. Also, p. 419, § 653 *b*; p. 424–425, § 662–663; p. 438–442, § 686; p. 489, § 756 *b*; p. 509, § 811; p. 510, § 814; p. 511, § 816 *b*; p. 538, § 848; p. 559–560, § 883 *b*; p. 723–724, § 960 *b*–961, 630 *c*, *e*, 970 *c*.

Sneezing,
when occasioned by the sun's light, the result of a double series of reflex actions of nervous system; and may be occasioned by the mind, when the nervous influence is simplified in being direct and reflex—employed to illustrate the modus operandi of morbific and remedial agents, both physical and mental, through alterative action of the same medium, and in demonstrating the substantive existence and self-acting nature of the Soul and Instinctive Principle, p. 340–341, § 514 *l*, *m*; p. 666–667, § 902 *c*; p. 890, § 1077.

Solidism and Vitalism. See Vitalism and Solidism, *Index II.*

Soul and Instinctive Principle. See, also, Soul, Instinct, *Index I.*; Mind, Will, *Index I. and II.*
physiological demonstration of, and distinguished from each other, p. 873–911, § 1069–1083.
the premises, relative to the nervous system, p. 873–874, § 1071.
mechanism and phenomena of reflex nervous action as forming the basis of demonstration, p. 873–877, § 1071–1072.
principle the same, whether the nervous influence operate through *reflex action*, or in a *direct* manner through excito-motory nerves alone, as when the nervous centres are directly impressed by physical causes or by the

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illustrate the great variety of causes by which the nervous influence is brought into active operation, either

Spasmodic Affections—*continued.*
in a *direct* manner by causes affecting immediately the nervous centres, or *indirectly* through reflex action of those centres, and operating, like the Will and Mental Emotions, through the cerebro-spinal system alone, or through that system and the ganglionic conjointly, and employed by the Author in advancing his application of the physiological laws of the nervous system to Pathology and Therapeutics, and his demonstration of the substantive existence and self-acting nature of the Soul and Principle of Instinct—and mistakes indicated in regard to the pathology of spasmodic affections, the misapplication of remedies, and distinctions to be observed, p. 319–320, § 494 *dd*; p. 331, § 500 *o*; p. 356–358, § 526 *d*; p. 590–593, § 891½; p. 874–877, § 1072; p. 879–881, § 1075 *a*, *b*. Also, Convulsions,

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Spinal Cord—continued from *Index I.*, late discoveries relative to its structure and functions, p. 802–803, § 1037.
experiments upon, and the brain, by A. P. W. Philip and Le Gallois to determine the laws of the vital functions, and others by Stilling, M. Hall, Van Deen, Girtanner, &c., employed by the Author in demonstrating the modus operandi of morbific and remedial agents through alterative influence of reflex action of the nervous system, and of the Will and Mental Emotions by direct action, p. 295–321, § 476–494. Also, Reflex Action, Mental Emotions, the individual *Passions*, *Index II.*; Will, *Index I. and II.*

Spontaneity of Being. See Generation, Spontaneous, *Index I. and II.*

Squill,
a stimulating Expectorant, unsuited to acute inflammation, and employed by the Author to illustrate the principles which should govern the treatment of pulmonic diseases, p. 638–640, § 892$\frac{4}{5}$ *f, g*.

Stethoscope,
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Stilling,
his experiments with Strychnia upon the spinal cord, and acetic acid to the skin, employed to illustrate Author's doctrine of the modus operandi of morbific and remedial agents through reflex action of the nervous system, p. 287–289, § 459 *c–g*; p. 319, § 494 *b–dd*.

Stimulants. See Tonics, *Index II.*

Stomach and Intestine, continued from *Index I.* See, also, Digestion, *Index II.*,
having assembled, as above, references to sections which relate to the functions of the stomach, it is simply an object now to bring together some of the many in which the Author endeavours to show that all remedies taken internally exert their primary effects upon the gastro-intestinal mucous tissue, and upon all other parts through alterative influences of reflex

Stomach and Intestine—*continued.*
action of the nervous system instituted by those primary impressions, with the exception of what may be due to continuous sympathy — and, for the foregoing purpose, the alimentary canal is considered in its special anatomical and vital characteristics, its special functions, its special relations to the nervous system, and the subordination of all parts of the body and of instinct to its final cause of supplying all parts with nutriment, p. 41, § 65; p. 62, § 135 *a*; p. 63, § 137 *c*; p. 65, § 143 *c*; p. 129–131, § 277–284; p. 143–146, § 322–326; p. 148–149, § 336; p. 193, § 356 *a*; p. 216, § 399; p. 229, § 419 *c*; p. 289, § 461; p. 335–336, § 512–513; p. 417, § 649 *c*; p. 430, § 674 *d*; p. 563–565, § 889 *a–g*; p. 668–669, § 889 *m, mm*; p. 667–669, § 902 *e–g*; p. 896–897, § 1078 *e*—and considering with this the exquisite susceptibility of the gastro-intestinal mucous tissue in its *sympathetic* sensibility (scarcely inferior to that of the lungs) to a variety of causes whose remote effects are manifestly owing to reflex actions of the nervous system instituted by the irritation of the tissue, as seen in the movements of the muscular coat, in the contraction of the sphincter ani, in the act of swallowing (p. 338–339, § 514 *f, g*, and *Index II.*), in the glow and moisture that often spring from the first contact of food with the stomach, and in the spasms that arise from its mechanical irritation, and in the vomiting occasioned by tickling the throat, by pregnancy, by disease of the kidney, by offensive odours, disgusting sights, and by their recollections, and as constitutionally displayed in infancy (p. 250–251, § 441 *c*; p. 327, § 500 *i–k*; p. 336–338, § 514 *a–e*; p. 339–340, § 514 *h*; p. 355–356, § 512 *a, b*; p. 374, § 576, *d*; p. 579–580, § 890½ *d*; p. 590–591, § 891½ *b*; p. 592–593, § 891½ *k*; p. 666–669, § 902 *c–g*), and taking along many unequivocal examples supplied by the Materia Medica, as emetics, cathartics, small doses of tartarized antimony (see the Articles, *Index II.*), and connecting with the foregoing many familiar analogies where diseases of various organs inflict disease sympathetically upon the alimentary canal, and the more numerous ones in which primary affections of the stomach and intestine light up disease in all other parts, and considering, also, how the primary affections are often cured by vesicants, the shower-bath, friction,

Stomach and Intestine—*continued.*
&c. (see Skin, and other Articles), and a large variety of other concurring facts which these general references will suggest, and which are readily accessible through our *Indexes*, we entertain the belief that our main object of demonstrating the instrumentality of the nervous influence, either reflex or direct, as the essential medium through which all remedial and morbific causes, physical and mental, exert their effects, and of contradistinguishing the laws of organic from those of inorganic beings, and of reclaiming from the Laboratory of the Chemist the several great branches of Medicine, might be safely left to the accumulated proof upon the subject before us, but, nevertheless, invite the attention of the Reader to the topics under the Article Generalization of Reflex Action of the Nervous System, *Index II.*; and Organic Chemistry, Vital Properties, Organic Life, Organic Compounds, Organic Heat, Ovum, &c., *Index I.*

Stomach, Blows upon,
operate, as in shocks from surgical operations, through a sudden and violent determination of reflex action of the nervous system upon the organic viscera—the modus operandi being also the same in principle as when sudden death is produced by hydrocyanic acid, the virus of serpents, drinking cold water when fatigued in hot weather, loss of blood, apoplexy, joy and anger, and illustrated by Le Gallois's and Philip's experiments upon the spinal cord, p. 107–108, § 227; p. 109, § 230; p. 114, § 234 *e*; p. 296, § 476 *c*; p. 297–299, § 476½ *c*–477 *a*; p. 300–301, § 479–480; p. 304, § 481 *g*; p. 307–308, § 483 *c*; p. 319, § 494 *b*; p. 334–335, § 509–511; p. 402–403, § 634, 635; p. 525–528, § 828 *a–d*; p. 670, § 902 *l*; p. 707, § 949.

"Strainage,"
the prevailing doctrine of, opposed by the laws which govern healthy and morbid states, by the endless variety of exact products in animals and plants, composed mainly of four elements in intimate union, but derived from fluids constituted of sixteen or eighteen, by the influences which are exerted upon the blood and all the fluids of the animal body by reflex or direct action of the nervous system, and by the analogy supplied by the admitted fact that the proximates of the bile have no existence in the blood, p. 21, § 22; p. 23–26, § 37–48; p. 27–28, § 52–53; p. 30, § 58;

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general division of organs and functions of animal life and of organic life, and their designations and uses, p. 53–54, § 96–106; p. 125, § 248–250—those of organic life quite analogous in lowest plants and animals, p. 54, § 107; p. 474, § 733 *f*—no organ of animal life necessary, p. 54, § 108—indispensable organs of a complex nature generally single, p. 54, § 109 *a*; p. 285, § 455 *c*—but the most essential parts are the extreme arterial vessels, to which the more compound organs are subordinate, p. 54, § 109 *b*; p. 227, § 411; p. 804, § 1040.
organs and functions relative to species and their sympathetic influences upon the general organism of animals—and their development a final cause of the whole in plants and animals, p. 55–56, § 118–123; p. 376–380, § 578; p. 817, § 1052 *c*. Also, Organs of Generation, Uterus, *Index II.*; Youth, *Index I. and II.*
law of dismemberment as it respects the germs and peculiarity of life in seed and egg, p. 56, § 122, 123.
the properties and laws through which it is developed, and carry on forever its functions, and govern all morbid changes, are shown by the elementary constitution of organic compounds to be totally different from those of inorganic bodies, p. 15–33, § 7–60; p. 50–52, § 83 *c*–84—and so allowed by Chemists who endeavoured to prove it otherwise, *ibid.*, p. 189–190, § 350¾ *n*, &c.—the pursuit now virtually dismissed from the Laboratory, p. 779–782, § 1028–1030—though reluctant-

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the same contradistinction shown by the incorporation of Nitrogen, p. 33–36, § 61–62—and by the developmental history of the Ovum, p. 36–49, § 63–80—and by Cells, p. 51–52, § 84—and by the development of cells in extravasated blood, and more particularly from their generation in simple protoplasm, p. 813–814, § 1051 *b.*
the properties, functions, and laws cannot be deduced from the structure, except in connexion with an observation of the results, which is the main source of information, p. 3, § 2 *c*; p. 50–51, § 83 *c*; p. 59, § 130, 131; p. 86–87, § 176, 177; p. 218, § 406; p. 353, § 525 *a*; p. 354, § 526 *a*; p. 801, § 1036—with analogies, also, *ibid.*, and p. 223, § 409 *e*—yet a knowledge of structure is indispensable, and at the foundation of all medicine, *ibid.*
each tissue distinguished by differences in organization and modifications of vital endowments, and these distinctions become more remarkable in the vegetable kingdom, where they correspond with the more fundamental distinction of organizing compounds out of the elements of matter—and undergo changes from infancy to adult age—and these differences are farther denoted by differences in vital stimuli, by the products, by the action of morbific and remedial agents, by the varieties in a common form of disease, especially inflammation—and these differences in vital endowments exist in different parts of one and the same continuous tissue, as in the gastro-intestinal and pulmonary mucous, p. 15, § 13–14 *b*; p. 52, § 85, 89; p. 61–70, § 133–160; p. 73, § 163; p. 82–83, § 172, 173; p. 88, § 185; p. 98, § 191 *a, b*; p. 138, § 303½; p. 140–141, § 306, 307; p. 218, § 406; p. 229–230, § 419 *c*–422 *b*; p. 353, § 525 *a*; p. 354, 526 *a*; p. 373–380, § 576–578; p. 473, § 733 *b*; p. 480, § 741 *c*; p. 522–523, § 827 *b, c*; p. 671, § 904 *b*; p. 815–816, § 1052 *a.*
each part has its own natural stimuli according to the peculiarities of its properties and functions, and each suited only to the several parts respectively, and may be poisonous to other parts—though arterial blood is adapted to all parts, p. 62–63, § 137 *a*; p. 671, § 904 *b.*
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certain tissues or parts of a continuous tissue more liable to disease than others, and to degrees of severity, according to the nature of the compound organ in which they may be associated, p. 64, § 138, 139; p. 70, § 160–162.
the difference in organization and vital endowments of different tissues in their relation to different compound organs, and of different parts of a continuous tissue, illustrated by *tabular* views of their relative liability to inflammation, and the relative degrees of danger, and the relative proportions of loss of blood as may be required by one part or another according to the compound organs with which they may be associated, p. 69–73, § 160–162; also, Bloodletting, Inflammation; Brain, Inflammation of, *Index II.*
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their relative functions, p. 57—another, of their secreted products, p. 218, § 406.
the simple tissues the seats of disease, and a knowledge, therefore, not only of their anatomical, but of the special vital characteristics of each is indispensable in practical medicine, p. 52, § 85; p. 61, § 133–134; p. 63, § 137 *b, c*; p. 64–65, § 138–143; p. 67, § 149–151; p. 467, § 718, &c.
upon the peculiarities in the special vital endowments of each tissue depends greatly the character of disease and the effects of remedies and of morbific causes, as exerted through reflex nervous action, p. 61–63, § 133–134, 137 *a–e*; p. 466, 467, § 715, 718; p. 652–656, § 892 *n*
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Structure—*continued.*
preternatural susceptibility or predisposition may be universal, and followed by a simultaneous explosion of disease in all organs, as in idiopathic fever, when, also, a single remedy may be adequate to the cure, and even when complicated with local inflammations, p. 65–67, § 143 *b–d*, 148; p. 367, § 557; p. 464, § 712; p. 465–466, § 715; p. 535–539, § 847–850; p. 664, § 900; p. 713, § 956; p. 731–732, § 907 *c*, also, Remedies, Fever, Inflammation, Predisposition, *Index II.*; Adaptation, Law of, *Index I.*—but where inflammations are attendant upon fever, and where many organs become invaded by uncomplicated inflammations or other forms of disease, the affections are apt to spring up consecutively as sympathetic consequences of each other, *ibid.*, and Causes, Morbific, *Index II.*
next to the distinction between Animals and Plants which relates to their modes of subsistence is the incorporation of the cerebro-spinal and ganglionic systems of nerves in all parts of the animal and organic life of Animals, each of which has special uses, respectively, and others collectively, and through the latter of which all parts of the organic mechanism are maintained in one harmonious concert of action, p. 54–55, § 110–116; p. 63, § 137 *e*; p. 110, § 232; p. 284–286; p. 290–295, § 462–475; p. 326, § 500 *g*; p. 330, § 500 *n*; p. 474–475, § 733 *f–i*—from which arises a general coincidence in the pathological as well as physiological condition of the whole, and renders them equally amenable to remedies; but alterative reflex nervous influence not equally reciprocal, p. 55, § 117; p. 63, § 137 *e*; p. 284–289, § 454–461½—and ultimately illustrated by the laws of reflex action of the two systems of nerves, and the Author's direct action through the Will and Mental Emotions, and applied to Pathology and Therapeutics, p. 284–289, § 454–461½; p. 295–335, § 476–511; p. 335–362, § 512–530. Also, Mental Emotions, *Index II.*; Will, *Index I. and II.*
the natural sympathetic relation of organs, through an unceasing reflex action of the nervous system, of the greatest practical importance, and evinces the highest order of Design, p. 58–59, § 126–129 *i*; p. 284–289, § 454–461; p. 328, § 500 *l*. Also, Reflex Action, Sympathy, as it respects tissues and complex organs;

Structure—*continued.*
CAUSES, MORBIFIC; REMEDIES, BLOODLETTING, *Index II.*
the sympathetic relations variously modified by disease, according to the special vital endowments of organs and tissues and the disturbances of the reflex nervous influence, p. 58–59, § 129 *d–i*; p. 67, § 149–151; p. 73, § 163; p 107–110, § 226–232; p. 110, § 232; p 286, § 456 *b*; p. 332, § 501 *c*; p. 661–663, § 894–896—in consequence of which, and as a natural result of the established relations, remedies call the alterative action of reflex nervous influence into profound operation, and develop curative reflex influences among organs diseased, and exact contributions from the unaffected, p. 59, § 129 *i*, and *references* there; p. 65–66, § 143 *c*, and *references* there; p. 661–663, § 894–896 Also, REMEDIES, SKIN, *Index II.*
hence, in view of the foregoing natural relations, and the differences in the vital constitution of tissues and organs, we readily understand the ground of the variety among sympathetic diseases, and how all organs may be disturbed by disease of one, p. 55, § 117; p. 59, § 129 *h*; p 64–65, § 140–143 *c*; p. 107–108, § 227; p. 332, § 501; p. 339–340, § 514 *h*, p 359–360, § 527; p 361, § 529 *b*; p. 415, § 647; p 423–424, § 660; p. 465–467, § 715–719.
STRYCHNIA,
employed, through the analogies of its spasmodic effects with convulsions that arise from teething, indigestible food, &c., and with traumatic tetanus, and in connexion with the counteracting influences of Antispasmodics, opium, &c., as one of the numerous illustrations of the less obvious modus operandi of morbific and remedial agents through alterative influence of reflex action of the nervous system, p 109–110, § 230–232, p. 111, § 233¾; p. 319, § 494, *b, dd*; p. 334, § 509; p 338, § 514 *d*; p 525–527, § 828 *a–d*; p 590, § 891½ *b*; p. 592–593, § 891½ *k*; p. 671–674, § 904 *a, b.* Also, CONVULSIONS, OPIUM, REMEDIAL ACTION, HYDROCYANIC ACID. ANTISPASMODICS, COFFEE, *Index II.* Also, p. 930, § 1088 *a.*
SUDORIFICS. See *Index I.* Also, SWEAT, SKIN; ANTIMONY, TARTARIZED; WATER, HOT, *Index II.*
SUGAR, ANIMAL,
whence derived, p. 784–793, § 1031 *b*–1033.
sugar of milk, a product of the mammary gland, and has no existence in
Sugar, Animal—*continued.*
the general mass of blood, p. 785, § 1031 *b*; p. 789–790, § 1032 *b.*
does it pre-exist in any part of the circulation, and is it a product of the liver? p. 783–793, § 1031 *b*–1033.
vegetable food not necessary to its production, p 785, § 1031 *b.*
diabetic, formed by kidney, p. 789, § 1032 *b*—restricted to diabetes, p. 786, § 1031 *b*—found in urine after pricking medulla oblongata, p. 792, § 1032 *d.*
saccharine matter not absorbed by lacteals, p. 788, 789, § 1032 *b.*
methods of searching for, p. 794, § 1033 *a. Placental* origin of, § 1086.
SULPHURIC ACID,
introduced as one of the proofs that Astringents and all other remedies operate upon parts beyond their direct seat of action through alterative influence of reflex action of the nervous system, p. 530, § 837 *c*; p. 533, § 842; p. 577, § 890 *o.* Also, LEAD, ACETATE OF; SILVER, NITRATE OF; OPIUM, COLD, IPECACUANHA, *Index II*
SULPHURIC ETHER, AND OTHER ANÆSTHETICS,
facts and arguments to show that they are not absorbed, but produce their constitutional effects through alterative influence of reflex nervous action —the philosophy being the same as concerned in respiration, where the reflex action is instituted by an inappreciable irritation of the pulmonary mucous tissue—and illustrate, also, the distinctions between common, specific, and sympathetic sensibility, p. 522–523, § 827 *b–d*; p. 862–864, § 1066; p. 671, § 904 *b.* Also, p. 101–102, § 201–202; p. 282–283, § 451 *d–f*; and STRUCTURE, ANÆSTHETICS, OXYGEN, *Index II*
SUPPOSITORIES
supply one of a thousand clear demonstrations of the operation of remedial and morbific agents upon distant parts through alterative influence of reflex action of the nervous system, and of the modifications of that influence according to the nature of the cause, while, also, in making their impressions partly through continuous sympathy, they concur with Croton Oil applied to the tongue, Leeching the anus, and Enemas of warm water, in showing how local impressions of this nature correspond with the nature of the agent, and give rise to a corresponding modification of the nervous influence, p. 666, § 902 *b*; p. 673–675, § 904 *b.* Also, p. 107–109, § 226–229, p. 661–663, § 894–896; and OIL, CROTON; LEECHING, HEAT;

Suppositories—*continued.*
SYMPATHY, CONTINUOUS; INFLAMMATION, *Index II.*; NERVOUS POWER, *Index I. and II.*
SUPPURANTS. See SETON, COUNTER-IRRITANTS, *Index II.*
SUPPURATION—continued from *Index I.*,
designed for useful ends, and its design, along with the production of lymph, displayed especially in deep-seated abscesses, p. 471–474, § 732 *b*–733. Also, p. 546–547, § 862–863; and MUCUS, PUS, LYMPH, INFLAMMATION, *Index II.*
SWALLOWING, DEGLUTITION,
like the involuntary and voluntary acts of respiration, and contraction of the sphincter muscles, illustrates the coincidences between the physical agents and the Will as equally substantive causes, and their common dependence upon the nervous influence (reflex in one case, direct in the other), as their medium of bringing the organic structures into action, and employed, also, in advancing the Author's demonstration of the operation of morbific and remedial agents and the Mental Emotions through the same causation, p. 338–339, § 514 *f*, *g*. Also, REFLEX ACTION, MENTAL EMOTIONS, RESPIRATION, SPHINCTER MUSCLES, SOUL AND INSTINCTIVE PRINCIPLE, *Index II.*; WILL, *Index I. and II.*
SWEAT—continued from *Index I.* See, also, SUDORIFICS, *Index I.*,
an unimportant evacuation, abstractly considered, and not a reliable or important symptom unless supported by others, and induced by causes of an internal nature that impart an alterative influence to the reflex action of the nervous system upon which it then depends, when it may be favorable or indicative of danger—and, as occasioned by remedies, it is conformable to the nature of each one, or as each may modify the reflex nervous influence, and it is the special impression that may be thus made upon the skin which does the essential service, and very little so the evacuation, as may be readily seen in the differences between the sudorific effects of hot drinks, fear, exercise, &c., and as they spring from tartarized antimony, ipecacuanha, loss of blood, opium, &c.—in one series of cases the nervous power operating as a simple stimulant, while in the other it is profoundly alterative of organic action; and in both the cases the skin may react through a corresponding nervous influence upon morbidly susceptible parts, and, therefore, with far greater
Sweat—*continued.*
effect in the latter than the former cases, p. 107–109, § 226–230; p. 111, § 233¾; p. 230–232, § 422 *b*–424; p. 250–251, § 441 *c*; p. 335–336, § 512 *a*, *b*; p. 338, § 514 *d*; p. 339, § 514 *h*; p. 350–351, § 524; p. 355, § 526 *a*; p. 451–452, § 692 *a*; p. 546–550, § 862–863 *f*; p. 550, § 863 *d*; p. 592–593, § 891½ *k*; p. 631–632, § 892¾; p. 634, § 892⅘ *a*, *b*; p. 661–664, § 894–900; p. 665–669, § 902 *a*–*i*; p. 678, § 904 *d*; p. 704, § 943 *a*. Also, SECRETION AND EXCRETION, SKIN, STRUCTURE, HYBERNATING ANIMALS, REMEDIES; ANTIMONY, TARTARIZED, *Index II.*; NERVOUS POWER, *Index I. and II.*
employed to illustrate modus operandi of Astringents through alterative influence of reflex action of nervous system, p. 530, § 837 *c*; p. 533, § 842; p. 577, § 890 *o*.
SYMBOLS, CHEMICAL,
as carried into Physiology, admitted to be fallacious, p. 779–782, § 1029, 1030.
SYMPATHY—continued from *Index I.*,
under this comprehensive designation are included *remote*, *contiguous*, and *continuous* sympathy, the first two representing reflex action of the nervous system, and the last having no manifest connexion with that action, but probably influenced by the nerves so far as they form a component part of the various tissues; and under the general designation are arranged the laws of reflex nervous action and the numerous experiments brought to their illustration, and introduced by the Author for the purpose of applying them to Pathology and Therapeutics—the order of the subjects proceeding as follows:
On the general Uses of the Nervous System, p. 284–290, § 454–461.
On the different Orders of Nerves, p. 290–292, § 462–470.
Laws of Action of Motor Nerves of the Cerebro-Spinal System, p. 292, § 471.
Laws of Action of Sensitive Nerves of the Cerebro-Spinal System, p. 292, § 472; p. 802–803, § 1037 *b*.
On the Spinal Cord, p. 292–295, § 473–475; p. 802–803, § 1037 *b*.
Experiments to determine the Laws of the Vital Functions, and applied to Pathology and Therapeutics.
1*st*. *On the Principle on which the Action of the Heart and Vessels of Circulation depends*, p. 295–301, § 476–479; p. 803–804, § 1039; p. 805–807, § 1041.

Sympathy—*continued.*
2*d. On the Relation which subsists between the Heart and Vessels of Circulation and the Nervous System; and the Influence of the Nervous System upon the Capillary Bloodvessels*, p. 301–310, § 480–485.
3*d. On the Principle on which the Action of the Muscles of Voluntary Motion depends, and the Relation which they bear to the Nervous System*, p. 310, § 486.
4*th. Experiments to ascertain the comparative effects of Stimuli applied to the Brain and Spinal Cord on the Heart and Muscles of Voluntary Motion*, p. 311–315, § 487–489.
5*th. On the Principle on which the Action of the Alimentary Canal depends*, p. 315, § 490.
6*th. On the Relation which the Alimentary Canal and Lungs bear to the Nervous System*, p. 315, § 491.
Review of the Inferences from the preceding and other Experiments, p. 315–321, § 492–494.
on the Varieties or Kinds of Sympathy, and applied to Pathology and Therapeutics, p. 321–335, § 495–511.
the Laws of Sympathy, or Reflex Action of the Nervous System, and their Application to Pathology and Therapeutics, p. 335–362, § 512–530.
1*st. General Facts and Laws relative to the Cerebro-Spinal and Ganglionic Systems*, p. 335–341, § 512–514.
2*d. Laws of Action of the Sympathetic Nerve, and the Propagation of Impressions in it*, p. 341–342, § 514½ *a*–515. Also, p. 216, § 399.
3*d. Of the Action of the Sympathetic Nerve in Involuntary Motions*, p. 342–349, § 516–521.
4*th. Laws of the Sensitive Fibres of the Sympathetic Nerve*, p. 350, § 523.
5*th. Laws of the Organic Functions of the Sympathetic Nerve*, p. 350–353, § 524. SYMPATH. NERVE, *I. 1.*
of the Sympathies of the Individual Tissues:
1*st. Sympathies of similar Tissues*, p. 353–358, § 525–526.
2*d. Sympathies of Dissimilar Tissues*, p. 359–360, § 527.
3*d. Sympathies of Individual Tissues in their Relation to each other in Compound Organs, and with entire Organs*, p. 360–361, § 528.
Sympathies of Compound Organs with each other, p. 361–362, § 529–530.
SYMPATHY, REMOTE AND CONTIGUOUS, terms of brevity, whose generic name is

Sympathy, &c.—*continued.*
derived from that of the nerve which, with the pneumogastric, is the principal channel through which reflex actions of the nervous system are conducted (and is thus employed by Müller and other Physiologists, p. 349, § 520; p. 352, § 524 *c*, &c.), and the only distinction between them consists in the greater limitation of the former to the cerebro-spinal axis as the central parts for reflected actions, while *contiguous* sympathy is manifested more particularly through local centres, which may consist of either the ganglia of the sympathetic nerve, or of plexuses of nerves, or of some portion of individual nerves (the last of which the Author, as will be seen, had considered probable, and which has been recently experimentally ascertained), but is, doubtless, always associated more or less with reflex actions conducted through the brain and spinal cord, as conspicuously manifested in the action of Vesicants and Leeches when applied over some internal inflammation, and, in its more circumscribed aspect, in the examples of dilatation of the iris at p. 673–674, § 904 *b*, and of the sciatic nerve at p. 838, § 1057½—and it now remains only to refer the inquirer for the practical applications of *remote* sympathy to the sections embraced under the Article REFLEX ACTION OF THE NERVOUS SYSTEM, *Index II.*; while he will find under the following sections the combined aspects of reflex action as conducted more or less through local centres of the nervous system, and its main centres, with various illustrations, and designated by the old name of CONTIGUOUS SYMPATHY, p. 287–289, § 458–461; p. 293, § 473 *c*; p. 294, No. 5; p. 312, § 487 *g*; p. 319, § 494 *dd*; p. 321, § 497; p. 323, § 499 *a*; p. 334, § 507; p. 343–344, § 516 *d*, Nos. 3–5; p. 345–346, § 516 *d*, Nos. 7–9; p. 349, § 520–522; p. 353, § 524 *d*, Nos. 4–7; p. 642–644, § 893 *a–c*; p. 646–653, § 893 *e–n*; p. 803, § 1038; p. 838, § 1057½.
SYMPATHY, CONTINUOUS, an old designation, and liable to the objection of being confounded with the laws of reflex action, and therefore the Author proposed the substitution of *continuous influence* (p. 322, § 498 *a*)—is common to Plants as well as Animals, but differing in the latter not only according to the nature of tissues (being far more strongly pronounced in some than in others, as in the veins and lymphatics), but by the

Sympathy, Continuous—*continued.*
incorporation of the nerves in all animal tissues (p. 483–484, § 746 *c*), and exemplified by the prick of a pin when the resulting inflammation extends in a continuous manner from point to point, or as seen in erysipelas, but sometimes remarkably limited in its progress, as at the divergence of veins, and shown, also, in a variety of other ways, as by the cathartic effect of croton oil applied to the tongue, by leeching the anus, by suppositories, and more or less by cathartics, especially such as act upon the liver, by the manner in which chewing tobacco, &c., excites the salivary glands, or irritation of the eye the lachrymal, &c., and is an element in venous circulation, but which, in all the cases, and according to the nature, extent, and force of the impression that may be continuously made, whether inflammatory, or simply an irritative, or a sedative effect, and according, also, to the nature of the tissue and of the compound organ, gives rise to a corresponding reflex action of the nervous system, which may fall upon various distant parts, and with all the variety of effect as set forth under Articles Reflex Action and Nervous Power, or may be directed upon the part which is the seat of the continuous affection and increase its extension and force, and thus multiply the force of the reflex action, and institute new circles and other influences upon other organs, p. 58, § 129 *c, f*; p. 64, § 141 *b*; p. 66–67, § 148; p. 209–210, § 387; p. 321, § 494 *e*; p. 322–323, § 498; p. 343, § 516 *d*; p. 350, § 523, Nos. 6, 7; p. 351, § 524 *a*, No. 2; p. 355–356, § 526 *b, c*; p. 465–466, § 715; p. 475, § 733 *h*; p. 483–484, § 746 *c*; p. 506, § 803, 804; p. 524, § 827 *e*; p. 526, § 828 *d*; p. 563–564, § 889 *a*; p. 694–695, § 923. Also, Oil, Croton; Leeching, Suppositories, Heat, Circulation of the Blood, *Index II.*; Venous Tissue, Venous Congestion, *Index I.*; p. 665, § 902 *a*. Note U.

Symptoms, Morbid,
distributed into five groups—1st, vital signs; 2d, relative to the instruments of disease, but independent of structural changes; 3d, relative to the secretions and excretions; 4th, of the foregoing nature, but determined or modified by changes of organization; 5th, of a physical nature depending on changes of structure, accumulated fluids, &c.—the first three being *primary*, the last two secondary, p. 435, § 681 *a*.

Symptoms, Morbid—*continued.*
describe the nature, seat, &c., of diseases, and often assisted by a knowledge of the predisposing causes, p. 424–425, § 662; p. 434–436, § 679–681; p. 459, § 705 *a*; p. 500, § 789; p. 560–561, § 885–887; p. 487–489, § 756; p. 509, § 811; p. 510, § 813 *b*; p. 545, § 859 *b*; p. 561, § 886.
owing to the instability of the properties of Life, *see* Vital Properties, *Index I.*, subdivisions—*mutable in their nature—their mutability designed for useful purposes—their mutability the fundamental cause of disease—their mutability the groundwork of cure—their mutability the great cause of the difficulties in Medicine.*
their uses and abuse, practically considered, p. 370–372, § 569; p. 428–434, § 673–676; p. 430–433, § 675; p. 436, § 682 *a, b*; p. 447–448, § 668; p 456–460, § 699–708; p. 489, § 756 *b*; p. 511, § 815; p. 548–549, § 863 *d*; p. 560–561, § 884–887; p. 572–576, § 890 *d–n*; p. 587, § 891 *k*; p. 590–591, § 891½ *a–f*; p. 626–627, § 892⅔ *l*; p. 636–641, § 892⅘ *d–i*; p. 724–725, § 961 *a, b*; p. 759–760, § 1005 *j*; p. 848, § 1058 *v–x*.
are apt to be regarded as the disease itself, without connecting them with the only useful considerations of which they are indicative, and remedies are accordingly addressed to a single symptom, p. 73, § 163; p. 464, § 713; p. 570–576, § 890 *a–n*; p. 579, § 890½ *a*; p. 584, § 891 *d*; p. 587–588, § 891 *k*; p. 589, § 891 *n*; p. 590–591, § 891½ *b–f*; p. 599, § 892 *d*; p. 626–627, § 892⅔ *l*; p. 628–629, § 892⅔ *r*; p. 630, § 892⅔ *b*; p. 633–634, § 892⅘ *a*; p. 637–640, § 892⅘ *e–g*; p. 684–688, § 905½ *b, c*.
diagnostic, and how far reliable, p. 436–437, § 682—*prognostic*, p. 437, § 683—other special ones—*pulse*, p. 443–448, § 687½–688—relative to *tongue*, p. 448–450, § 689—*secretions and excretions*, p. 450–455, § 690–694½. Also, Pulse, Tongue, Sweat, Urine, Mucus, Secretion and Excretion, Heart, *Index II.*
the force of, difficult to define, but a single one may denote a profound condition of disease, p. 438, § 685, No. 9; p. 442, § 686 *c*.
all of them to be considered in connexion, with a view both to the pathological cause and the treatment, p. 63, § 173; p. 73, § 163; p. 428, § 874 *a*; p. 437–442, § 684–686; p. 456–460, § 695–708; p. 479–480, § 741 *a, b*; p. 541–542, § 854 *bb*; p. 548–550, § 863 *d*; p. 551–554, § 867–871; p. 572

Symptoms, Morbid—*continued.*
–576, § 890 *d–n;* p. 587, § 891 *k;* p. 636–642, § 892¼ *d–i;* p. 663–665, § 897–901; p. 685–686, § 905½ *b;* p. 759, § 1005 *j.* Also PATHOLOGICAL CAUSE, *Index II.*
nevertheless, there is generally a group of symptoms which serve as a common index to pathological conditions and the effects of remedies, manifested by the heart and larger arteries, tongue, skin, and kidneys—organs that are not the seats of disease in most of the cases, but only exhibiting sympathetic influences as determined upon them by parts morbidly affected, or which may sustain impressions from remedial agents, and which go with a thousand other things in enforcing the importance of turning our attention away from the iatro-chemical and iatro-physical doctrines to the laws of sympathy or reflex action of the nervous system, and to the manner in which the nervous influence is variously modified and rendered alterative, for good or for evil, by disease and remedies, and according to the exact condition of one or the precise virtues, doses, &c., of the other, p. 230–231, § 422–423; p. 232–233, § 425–427; p. 350, § 523, No. 7; p. 355, § 526 *a;* p. 429–430, § 674 *d;* p. 438–441, § 686; p. 443–450, § 687–689 Also, PULSE, TONGUE, SKIN, HEART, KIDNEY, *Index II.*
mode of investigating. See SYMPTOMS, *Index I.*
SYNCOPE—continued from *Index I.*,
when occasioned by loss of blood, is owing to united effect of direct and reflex action of nervous system—when only by nausea induced by a variety of other physical causes remote from the stomach, consecutive reflex actions are instituted, being first determined upon the mucous tissue of the stomach with a nauseating effect, and thence with a prostrating effect upon the organs of circulation—and when induced by mental emotions, it may result either from the direct nervous influence acting immediately upon the circulatory organs, or from first instituting nausea, after the manner of disgust, and a consequent reflex action as in the last foregoing case—and the remedies consist of a variety of things which operate by instituting a stimulating reflex nervous action, having its centripetal origin in various parts, and taking a centrifugal course upon the centre of circulation—all the variety going with our other multitudinous facts and demonstra-
Syncope—*continued.*
tions in substantiating, by the force of exact analogies, the Author's doctrine of the modus operandi of morbific and remedial agents, physical and mental, through alterative influences of direct and reflex action of the nervous system, and of the modifications of that influence according to the nature of the causes by which it is brought into operation, and supplying simple elements of the manner in which the nervous influence, whether reflex or direct, will reach particular internal parts when, as in the former case, the centripetal impulse proceeds from a variety of sources, and how very dissimilar remote causes will bring about a common result, as seen in those which induce syncope, and in the other series which remove it, p. 703–706, § 942–945; p. 707–708, § 949; p. 709, § 951 *c, d.* Also, p. 107–111, § 227–233¾; p. 113–114, § 234 *d;* p. 312, § 487 *g;* p. 326–328, § 500 *g–m;* p. 331, § 500 *o;* p. 333, § 503; p. 338, § 514 *d;* p. 661–663, § 894 *b*–896; p. 664, § 900; p. 670, § 902 *l;* LOSS OF BLOOD, MENTAL EMOTIONS, DISGUST, STOMACH, REFLEX ACTION, *Index II.*
acupuncturation of heart proposed by Author in violent cases of, *in Medical and Physiological Commentaries*, vol. i., p. 178, *note*, 1840.

T.

TABLES *relative to* TISSUES. See STRUCTURE, *Index II.*
TEA,
the great calefacient of the Arctic traveller after long exposure to intense degrees of cold, and which, from its well-known influence upon the nervous system, goes with the rest in demonstrating the influence of reflex nervous action in the production of animal heat, and that, whatever may be its nature, its generation is on common ground with other secreted products, and liable, like the others, to be increased or diminished by the nervous influence, p. 811, § 1049. Also, ORGANIC HEAT, *Index I. and II.*
TEMPERAMENT—continued from *Index I.*,
its varieties, and corresponding differences in the effects of the natural stimuli of life and of morbific and remedial agents, that are mainly owing to slight differences in the organic property *irritability*, and to variations in the natural or the alterative influences of direct or reflex action of the

Temperament—*continued.*
nervous system, according to the nature of the physical cause or of the passion which may bring it into operation, and the analogies in Plants arising from substitutions of climate, cultivation, &c., and in their diseases, and some other facts closely allied to the foregoing, illustrate the broad distinction between organic and inorganic beings, and the fallacy of applying the chemical and physical doctrines to the problems of life, p. 88, § 183–185; p. 89, § 188; p. 95–100, § 189–193; p. 383–400, § 585–630. Also, Vital Properties, Organic Life, *Index I.*; Youth, *Index I. and II.*; Organs of Generation, *Index II.*

Temperature. See Organic Heat, *Index I. and II.*

Tetanus,
from the prick of a tendon, employed in corroboration of Author's doctrine of the operation of all morbific and remedial agents beyond the seat of their direct operation through alterative influence of reflex nervous action, and against the chemical and physical hypotheses, and farther to the same effect through its coincidence with spasmodic affections arising from a variety of other causes, p. 358, § 526 *d*; p. 526, § 828 *d*. Also, Spasmodic Affections, Hysteria, Convulsions, Antispasmodics; Hydrophobia, Virus of; Serpents, Virus of, *Index II.*

Therapeutics, p. 541–563, § 852–888.
the great ultimate object of all medical inquiries, p. 3, § 2 *b*; p. 413, § 639 *a*; p. 541, § 852.
simple in principle, complex in details, p. 541, § 852 *b*–853.
remedies of positive virtues are morbific in action, and therefore operate upon the same principle as the remote causes of disease—the difference being that the latter impair the recuperative principle more than the former, which substitute pathological conditions less profoundly morbid, and therefore capable of subsiding spontaneously, p. 333, § 503–506; p. 417–418, § 650; p. 430–432, § 675; p. 541–543, § 854 *a–e*, p. 544, § 857; p. 547–549, § 863 *d*; p. 551–553, § 867–870; p. 554–556, § 872; p. 644–652, § 893 *b–e*; p. 636–640, § 892$\frac{4}{5}$ *c–h*; p. 643–652, § 893 *b–m*; p. 669, § 902 *i*; p. 675–676, § 904 *b*; p. 679–681, § 905 *a*—often consist of natural means, p. 543, § 855; p. 600, § 892 *d*—or of simply withholding exciting causes, p. 543, § 856; p. 682, § 905 *b*—the cure being therefore essentially the work of Nature, p. 65–66, § 143 *c, d*; p. 67–68, § 149–152; p. 87, § 177–182; p. 122, § 239; p. 542–543, § 854 *e*, 856; p. 661, § 894 *a, mottoes*; p. 669, § 902 *i*—as illustrated by self-limited diseases, p. 544–546, § 858, 861, and by diseases of animals, p. 545, § 858; p. 551, § 863 *h*, and by the system of "watching," p. 558, § 877, 878—all of which depends upon the mutability of the properties of life as designed for useful purposes, as set forth under Recuperation, Law of; Remedial Action, Remedies; Causes, Morbific, *Index I.*; Adaptation, Law of, *Index I.*; p. 850, § 1059.
the morbid effects of positive remedies to be avoided only by a careful regulation of doses, &c., which shows them curative by introducing mild pathological conditions corresponding with the virtues of each remedy, although a great variety may institute the requisite changes in a given form of disease, as in intermittent fever, inflammation, &c., p. 543–544, § 857, 858; p. 547–550, § 863 *d*; p. 664, § 900; p. 669, § 902 *i*. Also, Counter-Irritants, Cantharides, Remedial Action, *Index II.*
each remedy, like morbific causes, operates according to its own nature, dose, &c., and therefore no two alike, and according, also, to two or more in combination and the relative proportion of each, the nature of the disease, &c., p. 27, § 52; p. 479–480, § 741 *b*; p. 544, § 857; p. 545, § 860; p. 547–550, § 863 *d*; p. 554–556, § 872. Also, Remedies; Causes, Morbific, *Index II.*
as every disease consists of a succession of pathological changes, it is the object of every successive remedy to introduce a new pathological condition till that one is attained which is most conducive to a spontaneous subsidence, and hence the importance of applying the right remedies, and in the right doses, and at the right time, and, as one remedy prepares the way for another, in a well-regulated consecutive order, and of projecting, as far as possible, a plan of treatment at its beginning, p. 67, § 149–151; p. 73, § 163; p. 87, § 177–182; p. 426, § 666; p. 428, § 672; p. 430–433, § 675–676; p. 473–474, § 733 *e*; p. 479–480, § 741 *b*; p. 543–544, § 857; p. 548–549, § 863 *d*; p. 553, § 870 *aa*; p. 554, § 871; p. 561–562, § 888 *a–d*; p. 566–570, § 889 *k–n*; p. 595–596, § 892 *aa*; p. 597–600, § 892 *c*; p. 608,

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§ 892½ *c*; p. 648–651, § 893 *g–k*; p. 657–658, § 893 *p*; p. 661–665, § 894–901; p. 664–671, § 899–902 *a–m*; p. 679–681, § 905 *a*; p. 696, § 926; p. 715–722, § 960; p. 728, § 964 *d*; p. 752, § 1000; p. 756–760, § 1005.
effect of morbid habit upon the action of remedies, p. 364–368, § 544–561; p. 552, § 869; p. 648–649, § 893 *g*; p. 696, § 926.
law of adaptation, dependent upon reflex action of the nervous system, profoundly interested, p. 62–63, § 136–137 *e*; p. 65, § 143; p. 67–69, § 149–156; p. 531, § 838; p. 535–539, § 847–850; p. 542–545, § 854 *f*–858. Also, Adaptation, Law of, *Index I.*; Diseases, Self-Limited, *Index II.*
no "specifics," but predisposing causes often modify a common form of disease, as inflammation and fever, in such modes as to require, more or less, the agency of remedies not adapted to the common form, p. 424–425, § 662; p. 487–488, § 756; p. 509, § 811; p. 510, § 813 *b*; p. 545, § 859 *b*; p. 551, § 865, 866; p. 561, § 886; p. 597, § 892 *c*. Also, Cinchona, Coffee, Iodine, *Index II.*
compound diseases often require a careful adjustment of remedies, p. 542, § 854 *f*; p. 545, § 858; p. 553, § 870 *aa*; p. 725–732, § 961 *b*–970.
advantage of combining remedies—cumulative effect of remedies. See Remedies, *Index II.*
effect of the mind upon the action of remedies, p. 865–868, § 1067 and *references* there—effect of pain in counteracting Narcotics, p. 557, § 874; p. 587, § 891 *k*; p. 590, § 891 *r*, and the same by the delirium of drunkenness, p. 590, § 891 *r*; p. 734, § 976 *b*—all the variety in effects being due to different modifications of the nervous influence as brought into preternatural action by the several causes respectively. See Reflex Action, Mental Emotions, the Individual *Passions*, *Index II.*
the curative effects of remedies upon the seat of their direct operation, particularly in morbid states of the stomach, is less owing to their direct alterative action than to a reflex action of the nervous system—and this corresponds with the morbific effects of many causes of disease when manifested in the seat of their direct operation, as seen particularly of cold and miasms—and problems of the same and more complex nature are involved in the salutary effects of exercise, change of air, &c., in dyspepsy, whooping-cough, phthisis, &c.—in all of which cases, as well also in all that concerns the operation of remedial and morbific agents beyond the seat of their direct action, the effects are owing to reflex influence of the nervous system—and for these several specifications see Reflex Action, Remedial Action, Sympathy, Remedies, Alteratives, Bloodletting; Causes, Morbific; Whooping-Cough, Phthisis, Exercise, Friction, Cold, Miasm, Shower-Bath, Sea-Sickness, Mental Emotions, *Index II.*; Nervous Power, *Index I. and II.*
diseases often subside spontaneously as others spring up sympathetically upon them, the nervous influence being the exciting cause in all the cases so far as any influences are sustained by the pathological conditions, the philosophy being also the same as when vesicants produce inflammation of the bladder, or aggravate or remove inflammations of other parts—the only difference between the morbific and curative effects being, that the reflex action of the nervous system is either more profoundly morbific or differently modified in one case than in the other—but, as it is the general tendency of diseases to generate others and to aggravate antecedent ones, and as the most favourable results of these reactions of the nervous influence are rarely salutary in the end, it is a great error to promote the continuance of natural diseases in the very slender hope that a greater evil may be thus overcome or an apprehended one avoided (not even the hemorrhoidal flux, though arresting it by a removal of its remote cause); and, although artificial diseases may be instituted in the skin by agents of transient effects with a view to salutary influences upon internal diseases, they cannot be set up in other organs, particularly the alimentary canal, but with an adverse effect—and it is upon this same principle that the habitual use of small doses of cathartics in a large proportion of dyspeptic cases overcomes constipation without detriment, while the indigestible food which is used for the same purpose proves morbific, p. 67, § 148; p. 351–352, § 524 *b–d*; p. 360–361, § 528, 529 *b*; p. 421–422, § 657, p. 506, § 804; p. 539, § 848; p. 559, § 882; p. 568–569, § 889 *m, mm*; p. 570, § 889 *n*; p. 652–656, § 893 *n*; p. 679–681, § 905 *a*; p. 695, § 924; p. 722, § 960 *g*; p. 856–862, § 1063–1065. Also, Cantharides, Counter-

Therapeutics—*continued.*
IRRITANTS, MERCURIAL REMEDIES, *Index II.*
the recuperative principle displayed in the secretions, their therapeutical uses according to their nature, and as supplying important suggestions in practical medicine, p. 230–231, § 422 *b, c;* p. 232–234, § 425–428; p. 352, § 524 *c;* p. 430–432, § 675; p. 450–452, § 691–693; p. 471–476, § 732–733; p. 633–634, § 832⅘ *a;* p. 635–640, § 892⅘ *h.* Also, SUDORIFICS, *Index I.;* ANTIMONY, TARTARIZED; DIURETICS, *Index II.*
emaciation curative, p. 551, § 863 *h;* p. 597, § 892 *c.* Also, REMEDIES (*Food*), *Index II.;* 984 *c.*
simplicity of treatment, a ruling principle, p. 553, § 870 *b;* p. 593, § 892 *a, motto.*
the *active* and *expectant* plans of treatment, p. 557–559, § 875–882—and the *rational* and *empirical*, p. 559–562, § 883–888 *b.*
four fundamental points—1st, the direct local effects of remedies—2d, their effects upon remote parts through reflex action of the nervous system—3d, their ultimate effects after their direct action is over—4th, the general influence of each remedy upon the course and termination of the disease, p. 562, § 888 *c.*
THIRST,
its earliest deleterious influences are exerted through reflex and direct action of the nervous system, the centripetal source being mostly the mucous tissue of the stomach and throat, progressively increased by the centrifugal action of the mind, while sooner or later a universal injury springs from the want of the necessary dilution of the blood—presenting, therefore, in the former aspect, the compounded influences that consist of reflex action, and the direct which results from mental emotions, and should be associated with the physiology of vomiting as determined by mental emotions and various physical causes, and asthmatic breathing, the examples relative to food, &c., in applying the philosophy to the modus operandi of morbific and remedial agents. See HUNGER, STOMACH, VOMITING, DISGUST, ASTHMA, RESPIRATION, SEA-SICKNESS, MENTAL EMOTIONS, SETON, *Index II.*
THORACIC DUCT, AND ABSORBENTS,
circulation in, depends upon suction power of the heart, and upon their own action, and upon that of the capillaries, p. 211, § 389, 390 *a.* Also,
Thoracic Duct, &c.—*continued.*
CIRCULATION OF THE BLOOD, *Index II.*
THUNDER,
physiology of its effects in producing disease through alterative influence of the nervous system determined in a direct manner, p. 631–632, § 892¾ *b,* and *references* there; p. 886–887, § 1067 *a.* Also, REFLEX ACTION, MENTAL EMOTIONS, DISGUST, *Index II.*
TISSUES. See STRUCTURE, *Index II.;* TISSUES, *Index I.*
TOBACCO—continued from *Index I.,*
the diversity of its effects—its fumes innoxious when inhaled, but poisonous to the alimentary canal—morbific from chewing on beginning its use, but becoming a luxury, while no repetitions will abate its pernicious effects when swallowed, or as an enema, or when applied to the skin, and an example of its special sympathetic effects upon the heart through the medium of the rectum, and an analogy supplied by sneezing as produced by snuff and light and by thinking of the paroxysm, and the coincidence in habit between the ultimate failure of chewing and smoking to affect the mouth, and snuffing the nose, and thus establishing a correspondence in these parts with the constitutional insensibility of the pulmonary mucous tissue to the fumes of tobacco, with other analogous considerations, contradict the hypothesis of absorption, and bring all the effects of tobacco under the law of reflex action of the nervous system, and present a comprehensive ground of analogy for sustaining our interpretation of the modus operandi of Anæsthetics, and its direct affinities in those respects with a multitude of other things of not less obvious action give to our demonstration an important weight in the general assemblage of facts as a ground of reasoning to other remedial and morbific agents whose modus operandi through reflex action of the nervous system is less manifestly pronounced—while, also, the effects of tobacco illustrate the difference in the vital constitution of different tissues, the law of Vital Habit in a limited relation of tobacco to the mucous tissue of the mouth and nose, &c., p. 61, § 133, *a, b;* p. 62–63, § 136–137 *c;* p. 67–68, § 149–152; p. 107–110, § 227–232; p. 323–328, § 500 *a–l;* p. 333, § 503–505; p. 338–341, § 514 *d–m;* p. 347–348, § 516 *d,* No. 13; p. 364, § 543; p. 522–524, § 827 *b–e;*

Tobacco—*continued.*
p. 527, § 829; p. 661–663, § 894–896; p. 665–670, § 902 *a–m*; p. 672–676, § 904 *b*; p. 679–681, § 905 *a*; p. 862–864, § 1066—and concurring with the foregoing is the frequent effect of the habitual and even temporary smoking in producing or aggravating piles—displaying, also, the special relations of a sympathetic nature which subsist between different parts of a continuous tissue, especially the mucous, and a complexity of reflex actions of the nervous system which are simultaneously determined upon the anal extremity through a primary action of the reflex influence upon the stomach and liver—all originating in the mucous tissue of the mouth, p. 350, § 523, No. 6, 7. Also, Skin, Stomach, Remedial Action, Anæsthetics, Narcotics (*Aconite*), Opium, Suppositories.
experiments showing it is not absorbed, p. 302, § 481 *c*; p. 306, § 483 *a*.
Tolerance of Remedies,
illustrated under the law of vital habit. See Habit, Vital, *Index II.*
Tongue
rarely sustains much disease, though generally suffers, in its surface at least, some modified action from the diseases of other parts, especially of the abdominal organs, arising from an alterative influence of reflex action of the nervous system, and serves, like the pulse, as an index of the nature of these reflected influences, and therefore of the nature and force of the remote diseases, and, although the universal and habitual examination of the tongue and pulse is purely an empirical inquiry, the philosophy of their signs has a deep foundation in the recesses of physiology, and is a luminous guide to the modus operandi of morbific and remedial agents through alterative influences of reflex nervous action, and to the development of diseases among distant organs as consequences of their own conditions, p. 448–451, § 689; § 826 *cc*; § 864. Pulse, Sweat, Kidney, Urine, Heart, Structure, *Ind. II.*
Tonics and Diffusible Stimulants,
the counterparts of Antiphlogistics, p. 579, § 890½ *a*—and comparatively of very limited importance, *ibid.*
have been extensively injurious, from erroneous hypotheses of disease and of their modus operandi, p. 579, § 890½ *a–c*. Also, p. 371–372, § 569 *b–e*; p. 395–396, § 621 *a*; p. 433–434, § 676 *b*; p. 541–542, § 854 *bb*; p. 572–576, § 890 *d–n*; p. 596, § 892
Tonics, &c.—*continued.*
b; p. 599–600, § 892 *d*; p. 715–722, § 959–960 *e*; p. 748–749, § 992 *b*; p. 752, § 1000–1001 *b*; p. 756–766, § 1005–1008; p. 772–776, § 1020–1026; p. 854, § 1061; p. 857–861, § 1063–1065, 1068 *a, b*; p. 872, P.S.
operate, like all other remedies, as alteratives through reflex nervous influence, which, as in all other cases, is affected in its action according to the special virtues of its exciting cause—with various illustrations drawn from the natural stimuli of life and from other remedial and morbific agents; as when, for example, solid animal food, taken by one long abstinent and during a long exposure to a chilling atmosphere, increases muscular vigor and lights up warmth of the skin as soon as it enters the stomach, and as diffusible stimulants and bitter tonic infusions will do the same, or, the converse of this, as when all the foregoing will alike instantly aggravate febrile excitement, showing throughout a common modus operandi; and since the solid animal food must exert its general effects through the medium of reflex nervous influence, so also do the tonics and stimulants, p. 579–582, § 890½ *d–h*. Also, p. 67–68, § 149–152; p. 107–110, § 227–232; p. 250–252, § 441 *c*; p. 303, § 481 *d*; p. 323–336, § 499–512; p. 563–567, § 889 *d–k*; p. 661–663, § 894–896; p. 679–681, § 905 *a*; p. 835–838, § 1057½, and Remedies, Remedial Action; Causes, Morbific; Cinchona, *Index II.* Also, p. 172, no. 94.
although no two are exactly alike in effects, they are more so than the members of other groups, and no one is an excrescence upon the Materia Medica; and, whether mineral or vegetable, as with other groups, will alike remove the same conditions of disease, and in conformity with the precise affinities of a chemical nature—or rather, how completely does all this variety of means, cinchona, iron, acids, shower-bath, exercise, hope, &c., appealing every where to our senses as well as understanding, expose the fallacy of applying the exact and exclusive laws of chemical affinities, or of any other physical hypothesis, in explanation of that one and the same result to which all the heterogeneous variety of remedies will lead, p. 581–583, § 890½ *g–h*; p. 664, § 900. Also, Remedies, Remedial Action, Cathartics, *Index II.*
the only conditions under which they are applicable, p. 580–581, § 890½ *e, f*.

Tonics, &c.—*continued.*
may be united with direct antiphlogistics, and why, p. 581, § 890½ *e*. Also, p. 487–489, § 756; p. 561, § 888 *b*; p. 727–728, § 964 *a*, *b*.—Note Ee.
their occasional success in removing inflammations is no proof of the accuracy of the distinction which has been made of the disease into active and passive, or that the pathology is not essentially the same, p. 486–489, § 752–756; p. 664, § 900.
difference between Tonics and Diffusible Stimulants, and the different conditions under which one or the other may be useful, showing, also, in their united effects, the important law by which one remedy may quicken the action of another by raising the irritability of the part or of the system at large, p. 581–582, § 890½ *g*. Also, p. 63, § 137 *d*; p. 65, § 143 *c*, *d*; p. 67, § 149–151; p. 367, § 556 *c*; p. 566–567, § 889 *k*, *l*.
Travers, Sir Benjamin,
his opinion of the Anatomical School of Medicine, p. 457, § 699 *c*.

U.

Ulceration
a consequence of inflammation, and conspicuous in its Design for useful ends, and has close analogies in Plants, p. 470–471, § 729 *a*–730; p. 472–476, § 733; p. 477, § 736 *c*; p. 478–479, § 740–741. Also, Pus, Lymph, *Index II.*
Ulcers
upon the extremities improved by open air through complex influences of reflex action of the nervous system, and the influences traced out, p. 662–663, § 896; p. 670–671, § 902 *m*. Also, Skin, Phthisis, Whooping-Cough, Exercise, Friction, *Index II.*
Uræmia. See Urea Diathesis, *Index II.*
Urea—continued from *Index I.*,
an artificial, not a natural product, p. 784, § 1031 *b*; p. 787–788, § 1032 *a*.
"Urea Diathesis," or Uræmia,
an imaginary evil, and "altogether remains to be proved," p. 787–788, § 1032 *a*. Also, p. 232–233, § 427.
Urinary Bladder,
excited to contraction equally by its contents, by the external application of cold and heat, and by the Will, and as the effect in the former cases is through reflex action of the nervous system, it must be the nervous influence in the latter; from which it follows that the action of the Will is prompted as much by a substantive agent as the urine is substantive, and since cold and heat simply denote an impression upon sympathetic sensibility of the skin by an abduction of caloric in one case and its stimulus in the other, and scarcely more appreciable as physical causes than the muco-pulmonary irritation which excites the nervous influence in respiration, we are thus in some degree aided in understanding how an immaterial substance may act upon matter; while, also, the several modes in which the nervous influence is determined upon the bladder in micturition, the variety of causes, the variety of centripetal nerves, and the limitation of the centrifugal influence to certain special nerves, along with a multitude of analogous examples, conduct us to a ready apprehension of a corresponding modus operandi of all morbific and remedial agents, both mental and physical, p. 111, § 233¾; p. 230–231, § 422 *b*; p. 347–348, § 516 *d*, No. 13; p. 630–631, § 892¾ *b*; p. 662–663, § 896. Also, Stomach, Skin, Kidney, Cold, Respiration, Phthisis, Amenorrhœa, Remedial Action, subdivision Mental Emotions, Organs of Generation, &c., *Index II.*
Urine—continued from *Index I.*,
analyses of, not reliable, and rarely of any importance, p. 228, § 417; p. 232, § 425–427; p. 450–451, § 691; p. 780, § 1029; p. 848, § 1058 *s*—but divert attention from the pathology of disease, and lead to imaginary evils, *ibid.*, and p. 833, § 892¾ *f*, and Symptoms, *Index II.*
not "strained off" from the blood, and its sudden increase or diminution, and most of its morbid changes, depend upon direct or reflected influences of the nervous system, p. 230–233, § 422–427; p. 450–451, § 691; p. 631–632, § 892¾. Also, "Strainage," Reflex Action, Fear, *Index II.*
the foregoing manifest exemplifications of the influence of the reflex action of the nervous system upon the secerning vessels of the kidneys, considered in connexion with the diuretic and sudorific effects of fear, and with the dependence of lactation, weeping, and all deviations of other secretions from their natural condition, upon the nervous influence either reflex or direct, as forming a part of the Author's demonstration of the modus operandi of all remedial and morbific agents, physical and mental, through the same causation—the nervous influence being simply excitant or depressant, or

Urine—*continued.*
variously modified and rendered alterative, according to the nature of the causes by which it is brought into preternatural operation, p. 106–111, § 233–233¾; p. 230–232, § 422–424; p. 249, § 441 *c*; p. 253, § 441 *d*; p. 262–263, § 446 *a*; p. 264–265, § 446 *c*, *d*; p. 289, § 461; p. 313–314, § 488; p. 317, § 498 *a*; p. 325–326, § 500, *ee*; p. 335–336, § 512 *a*, *b*; p. 338, § 514 *d*; p. 339–340, § 514 *h*; p. 347–348, § 516 *d*, No. 13; p. 351, § 524, No. 1; p. 352, § 524 *d*; p. 450–451, § 691–692 *a*; p. 453, § 694 *b*; p. 478, § 740 *a*; p. 546–549, § 863 *a–d*; p. 563–564, § 889 *a*; p. 631–632, § 892¾ *b*, *c*; p. 637, § 892¾ *d*; p. 662–663, § 896; p. 666–669, § 902 *c–i*; p. 704, § 943 *a*, *b*; p. 709, § 951 *c*. Also, Kidney, Mental Emotions, the individual *Passions*, *Index II.*; Nervous Power, *Index I. and II.*
its morbid fluctuations not often owing to absolute disease of the kidneys, but to diseases of other parts, especially disorders of the stomach, liver, and intestine, when it is to be regarded mostly as a symptom, like the pulse and appearances of the tongue, denoting the force and modifications of the reflex nervous influence as excited by the diseases of other parts, and therefore, more or less, their nature and force—from whence arises a corollary, that the administration of the so-called Diuretics for the purpose of promoting or otherwise modifying this secretion in the cases supposed is devoid of just pathological and therapeutical considerations, which should turn upon the diseases in which this symptom truly originates, p. 232–233, § 426, 427; p. 450–451, § 691; p. 630–633, § 892¾. Also, Pulse, Tongue, Skin, Heart, *Index II.*

Uterine Agents—continued from *Index I.*,
introduced to illustrate principles, and especially those which guided the Author in his therapeutical arrangement of the Materia Medica, p. 684–686, § 905½ *a*, *b*.
embrace a great variety of virtues, which are often mostly relative to various pathological conditions remote from the uterus, whose interrupted functions are apt to be rather unimportant sympathetic consequences, but frequently mistaken for the essential disease and the primary ones as ultimate effects, p. 628–629, § 892¾; p. 684–686, § 905½ *b*. Also, Emmenagogues, Amenorrhœa, *Index II.*; Menstruation, *Index I.*

Uterus,
susceptible in its mucous tissue of influences through reflex action of nervous system from various causes, internal and external, consisting of abdominal diseases, cold applied to the feet, pediluvium, lifting weights in pregnancy, many remedies, mental emotions, &c., according to the natural fluctuations that grow out of its special vital constitution, or as it may be affected in pregnancy, or by hydatids, or disease, p. 63, § 137 *b–d*; p. 65, § 143 *c*; p. 67, § 149–151; p. 111, § 233¾; p. 234, § 429, 430; p. 624, § 892¾ *d*; p. 628–629, § 892¾ *q–t*; p. 684–686, § 905½ *b*. Also, Cold, Skin, Leeching, Exercise, *Index II.*
considered in connection with aloes, cantharides, ergot, &c., and, as it respects aloes for the purpose, particularly, of illustrating the philosophy of its effects as an emmenagogue, and possibly as leading to abortion—showing that these effects are not in consequence of the supposed, though mistaken action of aloes upon the rectum, but that it arises from a special relation of this agent to the mucous tissue of all parts through which it determines an alterative reflex nervous influence upon the tissue in its preternaturally irritable states, being in this respect upon the same physiological ground as cantharides in its special action upon the genito-urinary organs, or as expectorants in their relation to irritable conditions of the pulmonary mucous tissue, and, also, to illustrate the special differences in the vital constitution of different tissues, and of the same tissue in different parts, and of different parts of one and the same continuous tissue, and the corresponding relations of remedial and morbific agents, p. 59, § 129 *h*, *i*; p. 61, § 132–133; p. 62–63, § 135 *a–d*; p. 65, § 143 *c*; p. 67, § 149–151; p. 73, § 163; p. 111, § 133¾; p. 231–232, § 424; p. 234, § 429, 430; p. 352–353, § 524 *d*; p. 366, § 556 *b*; p. 547–548, § 663 *d*; p. 556, § 889 *i*; p. 624, § 892¾ *d*; p. 628–629, § 892¾ *q–t*; p. 684–686, § 905½ *b*; p. 856–857, § 1063 *b*. Also, Cantharides, Ergot, *Index II.*
its development, and that of the ovaria at puberty, exerts a powerful influence in advancing the maturity of the general organism, through an uninterrupted reflex action of the nervous system, harmoniously with their relations in the perpetuation of the species, and this influence is forever aft-

Uterus—*continued.*
erward extended in subdued and modified conditions to the nervous centres, and reflected abroad with that variety of effect which is witnessed in the differences between the perfect and the altered animal, and brings the mind and its passions more or less under its sway, the nervous influence in the latter case falling as well upon the centres in which it originates as upon other parts; being, also, equally true of the other sex—and when with the foregoing are associated those long progressive alterative influences of reflex nervous action upon the mammæ which have their centripetal source in the gravid uterus, and unfold their great final cause, and the sudden increase of that action at the time of parturition, and the liability of the milk to be affected both in quantity and quality by mental emotions, another of our many isolated examples is presented, which, through its analogies, interprets the modus operandi of morbific and remedial agents, mental as well as physical, and defies in its own behalf, and in that of its analogies, every law that rules in the world of dead matter, p. 68–69, § 153–159; p. 80, § 169 *d*; p. 87, § 180; p. 88, § 185; p. 120–121, § 237; p. 231–232, § 424; p. 330, §500 *nn*; p. 335–336, § 512 *a*, *b*; p. 352, § 524 *d*; p. 376–380, § 578; p. 434–435, § 680; p. 662–663, § 896; p. 686, § 905½ *b*; p. 279–280, § 449 *a-d*, 625½.

V.

Vaccine Disease. See Small-Pox, *Index II.*

Van Deen,
his experiments, with others by Girtanner, Stilling, Budge, Home, and Johnson, proving that the poison of the viper in producing death is not absorbed, but exerted through the medium of the nervous system, and other analogous demonstrations, p. 319–320, § 494 *b–dd*; p. 525, § 828 *b*, *c*. Also, Hydrophobia, Virus of, *Index II.*

Varix,
its pathology, and employed to illustrate the dependence of venous congestion upon inflammation of the veins, p. 500–504, § 790–798.

Veins—continued from *Index I.*,
anatomical account of, in connexion with the circulation of the blood, and with the pathology of venous congestion, phlebitis, and varix, p. 210, § 386; p. 503–504, § 794–797. Also, Venous Congestion, *Index I.*
particularly liable to diffuse inflammation, as seen in phlebitis and venous congestion, p. 355–356, § 526 *b*. Also, Sympathy, Continuous, *Index II.*
the circulation in, depends upon several associated causes: 1st, the suction power of the heart; 2d, the action of the capillary arteries; 3d, concert of action between the capillary veins and arteries through reflex influence of the nervous system determined mostly by the varying quantities of transmitted blood and the existing condition of the arterial capillaries; 4th, an active contraction and dilatation of the veins simultaneously over a great extent by their longitudinal muscular fibres, in which continuous sympathy is especially interested, and which contributes to the foregoing reflex action, and, as a constitutional endowment, is at the foundation of their diffusive inflammation—this exposition, with the exception of the suction power of the heart, being propounded by the Author, p. 207–212, § 370–392 *a*; p. 214, § 392 *d*; p. 227, § 411; p. 355–356, § 526 *b*, *c*. Also, p. 21, § 22; p. 62, § 136; p. 80, § 169 *d*; p. 88, § 185; p. 223, § 409 *e*; p. 355–356, § 526 *b*; p. 474, § 733 *f*; p. 501–504, § 792–796; p. 506, § 803, 804; p. 507–509, § 806–811; p. 724–726, § 961; and Sympathy, Continuous; Oil, Croton; Leeching, Suppositories, *Index II.*
the suction power of the heart as a principal cause of venous circulation shown especially by the portal circulation, and that of the absorbents and umbilical vein, p. 211, § 390 *a*; p. 214, § 392 *c*, *d*; p. 212, § 391
the intestinal do not absorb, p. 128, 129, § 269, 277; p. 527, § 829. Also, Magendie, *Index II.*; Veins, *Index I.*

Venous Congestion—continued from *Index I.*,
propagates, on account of the special vital constitution of the venous tissue, a depressing reflex action of the nervous system upon the heart and arteries, as does also acute venous inflammation; but, nevertheless, this influence manifests in the condition of the pulse and blood, particularly in cerebral congestions, that pathological condition which, when affecting other tissues, demands a strictly antiphlogistic treatment, and which is confirmed by the effects of remedies, while, also, it exemplifies some of the

Venous Congestion—*continued.*
remarkable differences which exist among the tissues in their vital constitution, p. 61–63, § 133–137; p. 64, § 138–142; p. 67, § 149–151; p. 72, *Table* 3; p. 355–356, § 526 *b*; p. 444–446, § 688 *d–f*; p. 506–509, § 806–811; p. 511, § 815; p. 724–734, § 961–976; p. 735–736, § 978–980. Also, Venous Tissue, *Index I.*
and *congestive fever*, treatment of, particularly by bloodletting, or as quinine, &c., may be required in miasmatic forms, p 724–732, § 961–970. Also, Causes, Morbific; Miasm, Cinchona, *Index II.*
Veratrum Viride,
its late pretensions as a substitute for Bloodletting, p. 860, § 1065 *a*. Also, Tobacco, *Index I.*—Note I p. 1118.
Vesicants. See Counter-Irritants, *Index II.*
Vessels—See Blood-vessels, *Index I.*
the most important are the terminating series of the arterial capillaries, whose variety of functions and products, and their modifications as induced by morbific and remedial agents, and by mental emotions, through the medium of the nervous influence, and the analogies between the organic processes of animals and plants, concur with all things else in demonstrating the broad distinction between the laws that govern the organic and inorganic kingdoms, p. 220–227, § 409 *b*–411; p. 355, § 526 *a*. Also, Inflammation, Structure, *Index II.*; Composition, Organic Compounds, &c., *Index I.* Also, p. 215, § 394–399.
"Vestiges of Creation,"
introduced to illustrate the consequences of the Chemical doctrines of Life, p. 183–192, § 350¾ *f*–353; p. 925, § 1085.
Vision—continued from *Index I.*,
the latest interpretation of, as a chemical phenomenon, p. 798, § 1034.
Vital Functions. See Functions of Life, *Index I. and II.*
Vital Habit. See Habit, Vital, *Ind. II.*
Vis Medicatrix Naturæ—See *Index I.*
Vitalism and Solidism—continued from *Index I.*,
the doctrines of, continue to be essentially conceded by the Chemical School of Medicine, p. 779–782, § 1028–1030; p. 796–799, § 1034.
Vital Principle—continued from *Index I.*,
continues to be the incubus in the dreams of Organic Chemistry, p. 796–797, § 1034.
Vital Properties—continued from *Index I.*,
late experiments relative to, showing the distinction between the organic properties and the nervous power, and confirming the writer's philosophy upon this subject, that the former, through the instruments of action, carry on the functions, while these, in the animal kingdom, are constantly influenced by the nervous power as a vital agent, p. 803–808, § 1039–1044. Also, Vital Principle, Organic Life, *Index I.*; Iris, *Index II.*; Nervous Power, *Index I. and II.*
an agreement upon, between Dr. Carpenter and the Author, p. 95–96, § 189 *b*.
Volition. See Will, *Index I. and II.*
Volkmann,
experiments by, showing that the Skin is rendered by narcotization an extremely sensitive source of convulsions, and indicative of a broad distinction between the trunks of nerves and their expanded extremities—introduced, along with the analogies supplied by Cold, Friction, &c., to show that Vesicants, Setons, Issues, Mercury, Iodine, Tobacco, and other things applied to the skin, produce their effects upon internal parts through alterative influences of reflex nervous action, modified according to the nature of the agent, and the effects determined, also, according to the fluctuating susceptibilities of the organs, p. 338, § 514 *d*; p. 348, § 516 *d*, No. 13; p. 592–593, § 891½ *k*; p. 666–667, § 902 *b*–904. Also, Skin, Cold, Shower-Bath, Counter-Irritants, Seton, Leeching, Plasters, Tobacco, Sedatives (*Aconite*), Poultices, Mercurial Remedies, *Index II.*
Vomiting,
its physiological analogies to respiration, the great variety of means by which it may be determined that are incapable of absorption, including mental emotions, associate with their modus operandi through reflex action of the nervous system that of the true emetics, which, along with the profound physiological and therapeutical effects of the latter and the superficial ones of the former, concur with all our other demonstrations in bringing the modus operandi of all remedial and morbific causes, physical and mental, under one common philosophy, p. 325–328, § 500 *e–m*; p. 333–335, § 503–511; p. 336–337, § 514 *b*; p. 664, § 900; p. 666–672, § 902 *b*–904 *a*; p. 704, § 943 *a*–944 *a*. Also, Emetics, Stomach, Disgust, Sea-Sickness, Respiration, Reflex Ac-

Vomiting—*continued*
TION, REMEDIAL ACTION, MENTAL EMOTIONS, &c., *Index II.*
a constitutional provision for the exigencies of Infancy in man, but not of animals, illustrating their physiological distinctions, and presenting an elementary principle in the general plan of Organic Designs, showing, also, how all physical agents, whether natural, morbific, or remedial, correspond in their influences according to the existing physiological conditions, and, in connexion with its disappearance in advancing life, indicative of the natural changes that are incident to organs in their mutable properties, and that this mutability lies at the foundation of disease and its cure, and that, in correspondence with the changes in other organs, the nervous centres naturally fluctuate in their liability to developments of reflex nervous actions and in their modes and influences upon which vomiting, and much of the progressive mutations in organic life, and the corresponding effects of morbific and remedial agents depend, p. 373–381, § 576–579. Also, INFANCY, UTERUS, LACTATION, STRUCTURE, *Index II.*; VITAL PROPERTIES, ORGANIC LIFE, *Index I.*; YOUTH, NERVOUS POWER, *Index I. and II.*

W.

WARM BATH,
its effect in relieving pain and promoting sleep, the result of a sedative reflex action of the nervous system determined upon the nervous mechanism, p. 589, § 891 *p*, exemplifying, also, the modus operandi of Narcotics, Antispasmodics, &c., and the great recuperative law, p. 592–593, § 891½ *k*; p. 681–683, § 905 *b*; p. 838, § 1057½—while it equally extends its influence to all other parts through the same medium, operating according to the nature of the part and existing susceptibilities, being like cold in its action upon the kidneys a stimulus to the bladder, by which it will immediately determine its contraction, which is one of the numerous simple processes that interpret the modus operandi of morbific and remedial agents, and its relief of diseases according to temperature and the activity or indolence of morbid states and the nature of the affected part, presents a parallel with the effects of internal remedies according to their doses and analogous conditions, and

Warm Bath—*continued.*
thus farther illustrates the Author's doctrine of morbific and remedial action as applied to all cases through the medium of reflex nervous influence, and of his doctrine of modification of that influence according to the nature of its exciting causes, *ibid.*, and SKIN, COLD, KIDNEY, SEDATIVES, OPIUM, POULTICES AND HOT FOMENTATIONS; RECUPERATION, LAW OF; RESPIRATION, FOOD, EXERCISE, STRUCTURE, *Index II.*

WATER, HOT,
its effects in its action upon the stomach in producing free perspiration, like the glow and moisture of the surface which often spring from the first contact of food with the stomach, or as the odour or expectation of food increase the flow of saliva, or as the contact of cold air with the surface starts the secretion of urine, or as fear, and anxiety, and jealousy will do the same along with perspiration, or grief the tears, and all depending upon reflex or direct action of the nervous system, illustrates the perpetual operation of that influence in its most simple conditions in modifying the action of the secerning vessels, and the whole collectively stretch their conclusive analogies to the corresponding effects of emetics, cathartics, loss of blood, &c., and through their analogies, and independently of our other accumulated proof, to the various other simultaneous effects that are incident to morbific and remedial agents in their action upon parts beyond the seat of their direct operation, and thus also show how the nervous influence is variously modified in all the cases according to the nature of its exciting causes, and that the changes in the secretions are owing to these variously modified conditions, and proclaim the substantive existence and self-acting nature of the Principle in which the Mental Emotions originate—and now leaving the stomach for the rectum, and considering how the sphincter muscle is held in contraction by a perpetual determination upon it of the nervous influence, and that the natural peristaltic movements depend, also, upon reflex actions of the nervous system that have their centripetal origin in all parts of the gastro-intestinal mucous tissue, as much so as the muscles in deglutition in a more circumscribed portion, or all things that produce vomiting in the mucous lining of the stomach, and that it is through the same causation

Water, Hot—*continued.*
that an enema of warm water increases the intestinal movements, we become assured that their greater acceleration, and other attendant effects that result from the addition of salt, or soap, or aloes, &c., to the simple enema, depend equally upon the same reflected influence, and equally, therefore, when cathartics are administered by the stomach, since, also, if the enemas do not increase the peristaltic movements by their absorption, but, like the natural movements and the contraction of the sphincter muscle, and the act of swallowing, and the vomiting from drinking warm water or tickling the fauces, or a mental emotion, through the nervous influence, then, since there is no absorption, must all the other effects, curative or morbific, be equally due to that influence—and thus, finally, a broad ground of exact analogies is obtained for going in pursuit of an apparently endless variety of other concurring facts that are relative to the modus operandi of all other remedial and morbific agents, physical and mental, p. 107–111, § 226–233¾; p. 230–232, § 422 *b*–424; p. 289, § 461; p. 296, § 476 *c*; p. 301–302, § 481 *b*; p. 335–336, § 512 *a*, *b*; p. 339–340, § 514 *h*; p. 351, § 524 *a*, No. 1; p. 451, § 692 *a*; p. 478–479, § 740 *a*, *b*; p. 483–484, § 746 *c*; p. 534, § 844; p. 563–565, § 889 *a*–*g*; p. 630–632, § 892¾ *b*, *c*; p. 634, § 892⅘ *b*; p. 662–663, § 896; p. 667–670, § 902 *d*–*i*; p. 704, § 943 *a*; p. 866–867, § 1067 *a*. Also, Reflex Action, Remedial Action, Secretion and Excretion, Sweat, Bile, Weeping, Fear, Disgust, Cathartics, Emetics, Alteratives, Bloodletting, Leeching, Suppositories; Sympathy, Continuous; Soul and Instinctive Principle, *Index II.*

Weeping,
the result of an emotion, however violent, that rarely produces much disturbance, not even of the organs of circulation, since it determines the nervous influence mostly upon the lachrymal glands, as disgust does upon the mucous tissue of the stomach, and anger upon the voluntary muscles, while other emotions, like fear, impart to that influence a more universal direction—thus exemplifying, like the physiology of respiration, of the contraction of the sphincter muscles, &c., the manner in which morbific and remedial agents direct the nervous influence upon special parts, according to the nature of the former and the natural or acquired susceptibilities of the latter; and connecting the foregoing with the morbific effects of grief and the curative ones of hope and joy, we come to readily understand, through these facts alone, how the nervous influence is variously modified and rendered alterative by physical agents according to the particular virtues of each one—and these coincidences denote the substantive existence and self-acting nature of the Soul. See *references* under Water, Hot, *Index II.*, and p. 880, § 1074.

Whooping-Cough,
treatment of, p. 640, § 892⅘ *h*; p. 844, § 1058 *k*.
emetics break up a paroxysm by substituting a new modification of reflex nervous influence, since in coughing and vomiting the abdominal muscles are alike concerned, and when an emetic operates it introduces through the reflex nervous action a new combination of movements, and thus necessarily interrupts those upon which coughing depends, and for this reason should the cough, or tickling the fauces, or any other cause bring on vomiting, the paroxysm of coughing will be equally arrested; but in all the cases the results beyond the interruption of the paroxysm will depend more or less upon the special nature of the nauseant or emetic employed—all of which advances our other multitudinous demonstrations of the modus operandi of all morbific and remedial agents beyond the seat of their direct operation through alterative influences of reflex action of the nervous system, and against the crude devices of Chemistry, p. 111, § 233¾; p. 336–338, § 514 *b*, *c*. Also, Antispasmodics, Hiccough, Hysteria, Respiration, Stomach, Emetics, *Index II.*; Nervous Power, *Index I. and II.*—Notes D p. 1114, Cc.
philosophy of effects of open air and change of place in relieving—exemplifying a complex series of reflex actions of the nervous system as the immediately alterative means, a curative reflex influence being first propagated upon the digestive organs through a primary impression upon the mucous tissue of the lungs and skin, and subsequently through the improved or invigorated condition of the former organs upon the pulmonary mucous tissue; the same philosophy being applicable when change

Whooping-Cough—*continued.*
of climate, exercise, cold or warm bathing, friction, and analogous means promote the healing of superficial ulcers or assuage pulmonary phthisis, though the relief doubtless depends more or less upon reflex influences propagated directly from the skin upon the main seats of disease, or from the voluntary muscles as the result of their exercise, while, also, no small amount of what is thus apparently due to physical causes is often owing to a direct nervous influence excited by those emotions that are awakened by the gladdening aspects of Nature, by social intercourse, &c. —all of which is rendered tributary to the Author's general object of advancing that philosophy in medicine which appears to him to hold no fellowship with the institutions of inorganic Nature, p. 543, § 855–856; p. 579–580, § 890½ *d*, and *references* there; p. 662–663, § 896; p. 670–671, § 902 *m*. Also, Reflex Action; Causes, Morbific; Remedial Action, Mental Emotions, Hope, &c., *Index II.*
relieved by Antispasmodics through a sedative reflex influence acting upon the muscular tissue, p. 592–593, § 891½ *k*.

Will—continued from *Index I.*,
considered in its relations to the higher faculties of the Mind and to the Instinctive Principle, p. 877–881, § 1072 *b*–1075
acts upon the intestine in defecation as upon the bladder in fulfilling an analogous function, is sometimes capable of ejecting food from the stomach, or, on the contrary, will often restrain nausea, p. 325, § 500 *e*; p. 326, § 500 *h*. Also, Defecation, Sea-Sickness, *Index II.*
by its direct action upon the main centre of the nervous system it determines the nervous influence in an elective manner, and without regard to intermediate nerves, upon the voluntary muscles, which are thus brought into action by their own inherent properties, to which the nervous influence sustains the relation of a stimulus; and when it is considered with what vehement power the Will may urge the nervous influence upon the muscles of volition, we are supplied with an interpretation of the violence which excessive Joy, Anger, Fear, blows upon the epigastrium, surgical operations, prussic acid, the virus of serpents, &c., may inflict upon the organs of organic life through the same medium, p. 89, § 188; p. 103, § 205; p. 107–111, § 227–233¾; p. 124, § 243; p. 295, § 475½; p. 296, § 476 *c*; p. 298, § 476½ *h*; p. 300, § 479; p. 302. § 481 *b*; p. 319, § 494 *b–e*; p. 323–328, § 500 *c–m*; p. 334, § 509–511; p. 525, § 828 *a–c*; p. 643, § 893 *a*.

Will—*continued.*
with rare exceptions, it so disposes the nervous influence that it terminates without instituting reflex actions, as are apt to arise from Mental Emotions; but a remarkable exception occurs in sleeping in an erect posture, especially in roosting, and very analogous to that are the spasmodic affections (particularly of the muscles of the lower extremities when rendered susceptible by diseases of the abdominal organs) which arise from extending or "stretching" the limbs when in a horizontal posture, and as often experienced by the Author, p. 890–891, § 1077. Also, Roosting, *Index II.*
while the Will limits the nervous influence to whatever voluntary muscles it chooses, the Mental Emotions generally affect particular parts in their natural state according to the particular nature of each one, or as they may be compounded, as Shame the capillaries of the face, Grief the lachrymal glands and stomach, Disgust the stomach mostly, Fear the kidneys, skin, and heart, Anger the voluntary muscles, &c.; and what is thus true of mental emotions is more or less so of certain morbific and remedial agents of a physical nature, as Cantharides strikes at the genito-urinary organs, Narcotics, the brain, Mercury at the salivary glands, &c.; but in a general sense morbific agents are less circumscribed, and some of them, as the predisposing causes of fever, render the nervous influence universally alterative, and coming to conditions of disease this complexion is changed, and all external things, food, exercise, mental emotions, &c., present new phenomena, not only according to their nature, force, &c., but in parts upon which they may have no apparent effect in their natural states; and since the foregoing general limitation of the effects of morbific and remedial agents to particular parts according to the nature of the agent, and the part, and the varying susceptibilities, is entirely opposed to the diffusive action of galvanism and electricity, and as there is no analogy between the exciting causes and modifying influences of the nervous agent and those of which Chemistry takes any cognizance, and

Will—*continued.*
since the same limitation of effects applies in health with the precision of laws to the Will and Mental Emotions, and as the Will has the nervous medium through which physical agents produce their effects under its own self-acting control in its office of voluntary motion, and as some of the Mental Emotions rarely institute reflex actions, but are restricted to one half of the supposed galvanic circuit, and as the Will nearly always operates exclusively through the motor half,* the proof becomes conclusive that our Chemical friends must look for some other instrumentality than galvanism or any of their known agencies or laws to expound the problems of life and disease. See foregoing *references;* Causes, Morbific; Remedies, Mental Emotions, the individual *Passions*, Remedial Action, Reflex Action, Structure, *Index II.*
employed in demonstrating the substantive existence and self-acting nature of the Soul and Instinctive Principle, p. 874–879, § 1071–1075.

Y.

Yawning
may be the result of thinking about it, or of mental sympathy, or of weariness, and depends immediately upon complex influences of direct and reflex actions of the nervous system—the former cases displaying the incipient development by the direct action of the mind and a consequent institution, through its irritation of the pulmonary mucous tissue, of reflex action, as in involuntary respiration, and after the manner of Disgust in producing vomiting, while in the latter case the primary influence of the nervous centres proceeds from the voluntary muscles—employed in expounding the modus operandi of morbific and remedial agents, and in demonstrating the substantive existence and self-acting power of the Soul, p. 327–328, § 500 *j–m;* p. 340, § 514 *k–m;* p. 534, § 844; p. 631–632, § 892 *b;* p. 888–889, § 1077. Also, Disgust, Sneezing, Sea-Sickness, Exercise, Mental Emotions, &c., *Index II.*

Youth—continued from *Index I.*,
its various developments are strongly illustrative of the natural mutability of the properties of life which is greatly designed to fulfil the exigencies incident to the progressive stages from Infancy to Manhood, and from which arise diseases and their cure—thus supplying, also, natural examples of well-marked alterative influences of the nervous system in the deep recesses of organic life, since all the remarkable mutations which characterize this stage of progress, and much of its moral attributes, are mainly owing to the development of the organs of generation, and an attendant alterative influence of reflex nervous action, whose centripetal source is especially the testes in one sex and the ovaria in the other—and farther illustrated by the differences between the perfect and altered animal, while, also, the physiological changes become the groundwork of new diseases or modifications of former ones, and all serving as a standard of interpretation of the modus operandi of morbific and remedial agents, physical and mental, p. 55, § 117; p. 56, § 120; p. 61, § 133 *c;* p. 68–69, § 153–159; p. 121, § 237; p. 352, § 524 *d;* p. 376–378, § 578. Also, Organs of Generation, Parturition, Pregnancy, Alteratives, Predisposition, Miasm; Antimony, Tartarized; Reflex Action, *Index II.*; Vital Properties, Organic Life, *Index I.*

* The Chemist is desired to consider particularly this fact (§ 409 *hh*, 493 *cc*, 893 *a*). —Also Note Y p. 1130.

INSTITUTES OF MEDICINE.

NOTES.

As stated in the Preface to the Seventh Edition of this work, the Author has affixed some brief Foot-notes to that Edition (as at p. 172, 350, 593, 679, 725, 863, 895, 920); but soon after the first impression was struck off he concluded to introduce a few other Notes at the end of INDEX II., which will be attached to the copies of that impression which may remain on hand. This method of adding or modifying will be continued hereafter, and references to the NOTES thus appended will be inserted in the text in future impressions, and probably, also, other foot-notes, and other improvements. Such, indeed, have been made in this second impression of the seventh edition, as at p. 493, 606, 699, 1052, &c.—*September*, 1862.

NOTE A.—EXCITING CAUSE OF PARTURITION.

NOTE A.—In section 892⅔ *d* occur some remarks about the institution of labor, and I am now led to other comments by certain suggestions made by Professor G. S. Bedford, M.D., upon the same subject in his late work upon the "Principles and Practice of Obstetrics," and which was reviewed by myself in the "Boston Medical and Surgical Journal," November 7th, 1861. In that Review I remarked that Dr. Bedford, after a general examination of the principal hypotheses relative to "the *determining cause* of labor, or that peculiar influence which first excites the muscular fibres of the uterus to contraction," and having considered particularly the ovarian hypothesis of Dr. Tyler Smith, and the orificial irritation of Dr. John Power, both of which are founded upon the laws of reflex nervous action, delivers his own rationale in considerable detail. Our Author's doctrine is predicated of the principle that "there seems to be a necessary connection between the first spontaneous movements in the muscular walls of the uterus and a matured development of the muscular structure of the organ itself." That the institution of labor is due to a cause that operates at uniform times not only in the human species but in all animals is sufficiently obvious. It must be independent, in a constitutional sense, of all accidents that may affect the specific periods. The hypothesis of orificial irritation is contradicted not only by the periodical uniformity of the process, which is very variable in different species of animals, but by the variety of presentations, and that woman alone is liable to the imputed cause before the contractile movements shall have begun. We must therefore look to the uterus itself for the requisite provision, and this can be found only in a law which is exactly obedient to a matured development of the organ. But this does not expound the great and wonderful problem—the *how* or the *why* the "spontaneous movement" grows out of the "matured development of the muscular structure." Are there any analogies, any physiological principle, to sustain Dr. Bedford's conclusion that there is an inherent ability in the fully developed uterine muscular structure to institute the parturient process independently of any other existing cause, and above all that, as our Author affirms, "it has no connection whatever with a reflex or nervous force"? For this conclusion our Author offers a supposed analogy in the peristaltic movements of the intestine, founded upon the assumption that those actions are independent of the nervous influence, which, however, has not been rendered even probable. Experiments have only shown that other causes are capable of exciting those movements, such as atmospheric air, mechanical injuries, electricity, etc. (§ 262–265, 475½). In the natural condition of the intestine there must be equally an exciting cause of the peristaltic movements as of the action of the heart (§ 475½), or of the respiratory muscles (§ 500 *i–m*), or of the iris (§ 514 *k*, 1072 *a*), or of the sphincters (§ 514 *f*, *g*), and, as in the latter cases, what else than the nervous influence in that of the intestine?

And is not this confirmed by the effects of cathartics and suppositories (§ 514 *f*)? Why are the natural movements suspended in jaundice, or when food is long withheld, unless bile and the ingesta be remote causes of those movements, and how else can they reach the intestinal muscular tissue than through reflected action from the nervous centres? How else can the stimulus of the blood affect the muscular substance of the heart than through the circuitous route of the nervous system, or what other important function do the cardiac nerves subserve? (p. 303, Ex. 15; p. 321).

Physiologists are also greatly in error in supposing that the nervous influence ceases to operate immediately after apparent death, and therefore in the inference that the expulsive movements of the uterus after apparent death are not excited by the stimulus of the nervous influence. The expulsive efforts are ample proof that there is still remaining life; and various recorded facts substantiate the continued action of the nervous system as long as muscular irritability and contractility remain (§ 447 *d*, 637, 1042, 1072 *a*, NOTE AA, p. 1131).

As to the experiment of destroying the lower portion of the spinal cord for the purpose of showing that labor may take place without the stimulus of the nervous influence, it has been completely neglected that the uterus is still connected with the essential parts of the nervous system by contributions from the sympathetic nerve and from other parts of the cerebro-spinal system (§ 459 *f*, 478 *b*, 483 *c*, 490). Moreover, it is now well ascertained that the ganglia of the sympathetic nerve, even the plexuses of that nerve, are, as one of their uses, centres for reflected nervous action, especially when preternatural influences are in operation, as when, for example, vesicants subdue deep-seated inflammations (§ 516 *d*–522, 893). In the case of the parturient efforts after the destruction of the lower portion of the spinal cord, that very injury calls into operation other resources in the nervous system with which the uterus is indirectly supplied. It is also universally conceded that, in the language of our Author, "as a general rule, labor is in part accomplished through reflex nervous action," and it is therefore farther inferable that when labor takes place after destroying the inferior portion of the spinal cord "the general rule" still obtains, and that the experiment supplies no evidence that "childbirth is not necessarily dependent upon nervous agency." The supposed "inherent action" is, possibly, sufficient, *per se*, for a single contractile movement, but an exciting cause independent of the "matured development of the uterus" is necessary to a long series of alternate contractions and relaxations. That condition resulting from the "matured development of the muscular structure of the organ" becomes the exciting cause of reflex nervous actions, just as the want of atmospheric air in the lungs is the remote cause of the reflected nervous influence that determines the respiratory movements—excepting in the case of the uterus the compounded sensitive and excito-motory nerves, which are the channels of the transmitted influences, appertain exclusively to the muscular tissue of the organ. This, however, has its exact analogy in the reflex nervous actions upon which, as I have shown, roosting and sleeping in an erect posture depend, as also the spasms which are sometimes excited in irritable muscles of the lower extremities by a forcible act of the Will (§ 500 *dd*, 514, p. 891, § 1077). In the former case there is a natural adaptation of the muscles to that exercise of the Will, which, by placing them in a rigid state, establishes a reflex nervous action that maintains them in permanent contraction as in the more compounded case of the sphincter muscles. The same natural provision becomes developed in the gravid uterus to subserve the exigencies of parturition, and is allied to that irritable state of the voluntary muscles in which the Will may institute spasmodic movements. As soon, however, as "the determining cause" has initiated the process of labor, the point of departure for the reflected stimulus of the nervous power becomes compounded, and the fœtus participates as an exciting cause of the reflected nervous influence by its pressure upon the uterus. In this respect there exists an analogy in the first of the respiratory movements as related to all the subsequent, so far as the first in the series is determined by the contact of cold air or other physical causes acting upon the surface of the body, while in all the subsequent movements the point of departure for the reflected nervous influence is the mucous tissue of the lungs.

As to the alternate contractions and relaxations that are maintained by air, mechanical injuries, electricity, &c., in the extirpated intestine and heart, and where there may be no reflected nervous influence determined by those causes through local centres of the sympathetic nerve, such alternations of action are as readily produced by the artificial irritants as by the stimulus of the nervous power in virtue of the natural constitution of those organic muscles, which are specifically designed for that mode of action (§ 262–265, 475½ and *references* there, 476½ *c*, 490, 498 *e*, 500 *c–e*, *o*, 514 *f*, 516 *d* 8 and 9, 891, 892¾, 1077).

NOTE B.—POISONS AND THE ORGANIC NERVE.

Note B.—Some late Experiments by Peliko and Dybrowski, showing the action of certain poisons upon the heart, exemplify the transmission of influences through the sympathetic nerve in the absence of the brain, as set forth in § 461½, 477-478, 481 *Exp.* 14, 15, 483 *c*, 484 *b*, 487 *f*, *g*, 488½, 490, 494 *Exp.*, p. 675, § 904 *b*. They are introduced here, therefore, not on account of their supposed novelty, but as new contributions in support of the doctrines which I have advanced as to the *modus operandi* of morbific and remedial agents through reflected influences of the nervous system, and as showing that these influences may be fully propagated through the sympathetic nerve, as is also seen of the natural stimuli in the anencephali (§ 461½ *a*).

According to a communication made to the Parisian Academy of Sciences by the foregoing Physiologists, poisons derived from the upas antiar, tanghinia venenifera, veratrum viride, digitalis purpurea, introduced into the stomach or inserted in the skin of frogs, arrested the action of the heart in periods varying from ten to twenty minutes, leaving the animal for some time with the exercise of voluntary motion. They found this paralyzing influence to be equally the same when the brain was separated from its connections with the spinal cord, from which they deduce the conclusion that the poisons exert a peculiar effect upon the nerves supplying the heart or such as may influence the movements of the organ. By consulting the references to the Institutes as suggested in this Note, it will be evident from similar experiments long since made (by Brodie, for example, with tobacco, p. 675, § 904 *b*), that the heart was not paralyzed in the foregoing cases through an absorption of the poisons, but by pernicious influences reflected by central parts of the nervous system.

The experiments possess, also, the interest of showing the difference in functions between the cerebro-spinal and ganglionic systems, and the transmission of influences in organic life (as in the case of the Will in animal life), through special organic nerves, according to the nature of the remote causes and the natural or acquired susceptibility of organs (§ 137–152, 233¾, 500 *g–m*, and *Note* at p. 864).

NOTE C.—ORIGIN OF DEATH.

Note C.—Refers to section 632, page 401. Nothing upon the subject of death can be predicated of man as deduced analogically from the original constitution of animals. The weapons of destruction with which the latter are provided is a cogent proof that death was their primitive allotment, and a still greater may be seen in the universal means of subsistence among the aquatic tribes and the carnivorous of every denomination. The last reaches to man, for whose uses the animal as well as the vegetable kingdom was created, and in which respect the pronunciation of Scripture corresponds with the constitution of man, which is obviously designed for both animal and vegetable food. Man is not only thus isolated, and all reasoning from analogy predicated of the death of animals excluded, but since, also, animals were rendered subservient to mankind as a means of sustenance, and as the death of man is not tributary to any useful purpose whatever in the economy of nature beyond the mere elementary principle, it is evident that death has been ingrafted upon man's constitution without any apparent final cause. This conclusion, though wanting in absolute proof, is prompted by reason in its logical methods of investigation, and it seizes upon Revelation as supplying a remarkable concurrent testimony of the accuracy of its own ratiocination, and as affording a satisfactory solution of the wonderful problem. But that is not all. Man is still more estranged from the brute creation by his endowment, according to my induction from final causes (p. 893), with an imperishable Soul, while the instinctive principle of animals dies with the material body. The analogy, therefore, which has been carried from the mortality of animals to the human race is again rendered nugatory by the final causes of the Soul and of the principle of Instinct (p. 842, § 1078).—Note Pp p. 1142.

NOTE D.—REFLEX NERVOUS ACTION.

NOTE D.—The demonstrable manner in which light produces *sneezing*, or the mind in dwelling upon the paroxysm, as set forth in § 514 *k–l*, 1077, and in which disgust, whether arising from offensive sights or offensive odors, or from a recollection of their effects, gives rise to *vomiting*, as expounded in § 500 *i–m*, 503–512, 514, 892¾, 1074, 1077, and as an attendant result to *sweating* (*ibid.*), and where in the latter case the nervous influence is conspicuously manifested as well in the organs of organic as of animal life, enables us to readily comprehend the involved processes of reflex nervous actions that may be instituted by remedies administered by the stomach or applied to the skin, as variously set forth in this work (§ 228 *b*, 514 *h*, 657, 674 *d*, 692 *a*, 715, 811, 848, 863, 889 *a*, *n*, 902 *g*, 904 *bb*, and *Index* II., Article SKIN). Thus, also, it is rendered manifest how agents of special virtues may not only propagate a curative reflex nervous influence directly upon a morbidly susceptible part, as tartarized antimony in the cure of pneumonia, but how, also, the same remedy may simultaneously reflect the nervous influence upon other organs not the seat of disease, as the skin, and thus render that organ the source of a salutary reflex nervous influence upon the morbidly susceptible lungs, as otherwise and variously expounded in the foregoing and other sections.

It may be farther said of *sneezing* as brought about by the action of light upon the retina, or by the mind in dwelling upon the paroxysm, and of *vomiting* as occasioned by offensive sights and offensive odors, that in the former case the nervous influence, in being first *reflected* or *directly* projected (as the light or the mind may be the remote exciting cause) upon the Schneiderian membrane, acts upon that membrane after the manner of *snuff*, when the irritation is reverberated upon the nervous centres, the nervous influence again excited and reflected upon the abdominal muscles; while in the case of vomiting, it is the mental emotion alone which excites and projects the nervous influence upon the mucous coat of the stomach (always in a *direct* manner, according to a distinction which I have made between *direct* and *reflex* action, § 227, 500 *c–m*, 893 *a*, 896, 903, 1072 *a*, 1074), where the nervous influence thus determined by the emotion, whether resulting from the spectacle, or the odor, or from the recollection of their effects, acts precisely as an emetic, when the chain of causations ends in the transmission of that nauseating influence to the nervous centres where the nervous power is thus excited in an *indirect* manner, and then reflected with a convulsive effect upon the same muscles that are engaged in sneezing.

The foregoing examples are reproduced here that they may be presented in an isolated state, and to attract to them attention both on account of the novelty of the Author's interpretation of the action of the Will upon the voluntary muscles, and of mental emotions upon all parts of the organic mechanism, through the instrumentality of the nervous power, and that they may be recognized as distinct illustrations of the modus operandi of natural, remedial and morbific agents in refutation of the doctrine of operation by absorption.

NOTE E.—OPERATION OF NARCOTICS.

NOTE E.—In expounding the therapeutic effects of *Narcotics* I have endeavoured to show that they operate essentially by reducing irritability and sensibility, and thus render the blood and other exciting causes less stimulating, so that in local conditions of disease attended by an exaltation of those properties the restorative process supervenes upon that sedative influence (§ 891 *i*, 905 *b*, 1057). These remarks are intended to illustrate the probable action of *Conium* and *Belladonna* in mitigating the severities of cancerous affections, and that the results are in no respect due to an alterative virtue which has been for a long time attributed to those narcotics.

NOTE F.—ALCOHOL *versus* ANTIPHLOGISTICS.

NOTE F.—To carry out the objects of the POSTSCRIPT at p. 872 I subjoin the statistics of mortality arising from *pneumonia*, *bronchitis*, *croup*, and *consumption* in the city of New York during the months of January, February, March, and April of

1861 and 1862, from which it will be seen that the "stimulating plan" of treatment was no more successful than in the same months of 1860.

In 1861 the total number of deaths during the foregoing months was 6987, of which 527 are reported as "INFLAMMATION OF THE LUNGS;" BRONCHITIS, 185; CROUP, 212; CONSUMPTION, 1062.

In 1862 the total number of deaths for the same time was 7035, of which are reported as "INFLAMMATION OF THE LUNGS," 498; BRONCHITIS, 119; CROUP, 187; CONSUMPTION, 1165.

The ratio of deaths from pneumonia during the first four months of 1861 and 1862 was about the same as distinguished the corresponding period of 1860, while, had the depletive treatment been adopted, especially bloodletting, which continues to be proscribed in this City of New York, that ratio, instead of amounting to about 1 in 12 of all the deaths, would not have been 1 in 100. The aggregate mortality, therefore, I reiterate, must not be imputed to any remarkable insalubrity of New York (p. 760, § 1005 *k*).—NOTE MM p. 1141.

As to the ratio of deaths from Consumption, some improvement may be anticipated from the late work upon that disease by Dr. James Copland, who advocates the antiphlogistic treatment, especially in the early stages. It will, however, be a tardy gain over the stimulating treatment, since it is said, in the leading medical journal of the day, by a rather liberal reviewer of Dr. Copland's work, "that bleeding for hæmoptysis is not a practice which meets with much favour in the present day. Most living physicians with whose opinions we are conversant would as soon think of drawing blood to arrest uterine hemorrhage, or to stop a wounded artery (§ 699 *c*, 805, 862–864, 890 *d–f*); and, secondly, that the main improvement (in treatment) depends on the *universal acceptation* of the doctrine that phthisis is essentially a disease of imperfect nutrition and assimilation, and that efforts in treatment must therefore be mainly directed, not to the *pulmonary*, but to the digestive systems. The principal treatment of phthisis nowadays consists in the *free administration* of nourishing *animalized* diet, containing a large proportion of the FATTY elements of nutrition; in exercise, with unrestricted exposure to the invigorating influences of sun and air; and in the substitution of a few simple but effective *tonic* medicines for the effete polypharmacy of our predecessors." The objection to polypharmacy is very well, although it does not apply to any of the most eminent "of our predecessors," whose principal treatment in the early stages of phthisis consisted of bloodletting, a non-stimulating diet, counter-irritants, and free exercise in the open air, but all of which, save the air we breathe, is now so greatly changed that the Reviewer remarks of Dr. Copland's treatment that "we have certainly been surprised to find LOCAL, and in some instances general bloodletting still advised in the first stage of phthisis." —(The *Italics* are mine.)—BRITISH AND FOREIGN MEDICO-CHIRURGICAL REVIEW, January, 1862, p. 159.

Now there might seem in the foregoing statistics a sufficient justification of this extended discussion. But it may be said that they are too local, not sufficiently comprehensive, and that as *statistics* (founded upon the "*numerical method*") are "the great criterion nowadays of the merits of treatment," they should not be liable to the objection which I have anticipated, although they run through four corresponding months of three consecutive years, and relate to a population of about one million. I shall therefore offer a copious amount of similar testimonials from the same number of the Review to which I am indebted for the foregoing quotations. Thus, in an elaborate Article upon "Military and Naval Hygienics" (the *Italics* being mine), it is said of "Diseases of the Lungs, &c., including pulmonary consumption," that, "among the troops at home, these maladies occasion more admissions into hospital than all fevers and diseases of the bowels together; and *more than three times as many* deaths. *Two thirds of all the mortality* in the army of the United Kingdom are due to them; and of these two thirds, *four fifths* are due to consumption." "In the Mediterranean garrisons, the proportion of chest diseases to all other causes of sickness has been nearly as high as in Great Britain, viz., a sixth or a seventh of the whole. They have not been quite so fatal; still, the mortality from them alone has constituted between a *half and a third of all the deaths.* In the North American command, their frequency and fatality have been nearly the same as at home.

"In the *navy*, respiratory diseases are the most prolific source of sickness and death." "*More than a fifth* of the deaths from all causes is occasioned by them." "In 1856, out of a total mortality of 629 from disease, 175 deaths were due to pulmonic affections, chiefly phthisis (nearly one fourth); and of the 918 men invalided from disease that year, 103 were *discharged* on account of consumption, and 49 from

other pulmonic disorders. In 1857, of the total deaths (623) from disease in the service, 129 were caused by consumption" (more than one fifth).—IBID., p. 109, 110.

In reviewing the statistics of consumption, it should not be forgotten that besides the substitution of tonics and stimulants for the "effete polypharmacy of our predecessors," a lavish use of cod's liver oil is a main ground of dependence; though we hold the tonics and stimulants, and the "free administration of nourishing animalized diet," and the absolute neglect of an antiphlogistic treatment, at the early stage of the disease, responsible for the excessive mortality (§ 836, 892$\frac{4}{5}$ *g–i*).*

In the MEDICAL AND PHYSIOLOGICAL COMMENTARIES, in an article on the "*Pathology of Tubercle and Scrofula*" (vol. ii., p. 608–634) and, also, in a critical examination of the "*Principal Writings of P. Ch. A. Louis*" (*ibid.*, p. 679–815), I have endeavoured, at great length, to substantiate the highly inflammatory nature of phthisis pulmonalis, and have recited the experience of the most illustrious practitioners in behalf of a decided antiphlogistic treatment, especially bloodletting, in the early stages of the malady, and with which my own, throughout a long and active professional life, has fully corresponded. But there has arisen a general, or, rather, a nearly universal acquiescence in Louis' *contra-inflammatory* doctrine, as deduced by him from the *débris* of the body, though, as I have unquestionably shown, in opposition to his own dissections (e. g. *ut supra*, p. 631–633). It is this especially, not the "*numerical method*," and as generally admitted, which has prompted the stimulating treatment of consumption (§ 756 *a*). Moreover, in respect to this, and all other diseases, the denunciation of bloodletting is too formidable to be encountered by any but well-established practitioners, and who possess, also, more than Galen's heroic firmness (§ 1004 *c*, *note;* also p. 488, § 756 *a;* p. 722, § 690 *g;* p. 861, § 1065 *c*).

NOTE G.—MODUS OPERANDI OF CATHARTICS.

NOTE G.—The explanation which is rendered in § 889 *f* of the necessity of profound impressions upon the intestinal mucous membrane by cathartics for successful

* In regard to the causes which have led to an almost universal adoption of a stimulating treatment where the "antiphlogistic" had, with only rare and partial exceptions, obtained throughout the past (§ 1004 *a*), I have represented those of a general nature both in this work and the Medical and Physiological Commentaries (§ 487 *h*, 569 *b–e*, 621 *a*, 743, 756 *a*, 785, 815, 860, 861 *b*, 967, 979, 992, 999 *c*, 1001, 1005–1007, 1022–1026, 1068 *a*, *b*). But there are many incidental causes, which have given a great impulse to the revolution, and a knowledge of which will be interesting to the future historian. Among the thousand influences of this nature, which are of themselves of important and comprehensive import, may be mentioned the following recommendation, signed by nine of the principal physicians of the City of New York (six of whom, at least, are Professors in some of our Metropolitan Colleges), and which, of course, has been extensively circulated as an advertisement. Thus:

"New York, May 1, 1861.

"MR. WM. T. CUTTER, Jr., Louisville, Ky.

"DEAR SIR,—The great difficulty experienced in procuring Brandy sufficiently pure for medicinal purposes, has induced many of the physicians of this vicinity to adopt Bourbon Whisky as a substitute, both in the hospitals and private practice; and since the latter HAS COME INTO SUCH GENERAL USE, we have reason to believe that a great deal now sold is of very inferior quality.

"Presuming that your residence in the vicinity of the manufacturers of Whisky in Kentucky, as well as your skill as a chemist, will enable you to select a reliable article, and having full confidence in your integrity, we are led to inquire whether you will not aid us in having this market supplied, through an agency, with the best quality of Pure Old Bourbon Whisky for the use of the sick."—*The capitals are mine.*

Another favourite stimulant, known as Wolfe's *Schiedam Schnapps* (or, more familiarly, Holland Gin), is worthy of notice on account of its special recommendation by high medical authority. This gin has enjoyed a distinguished professional patronage and a brilliant career for many years, and the appetite for it has been very recently sharpened by a fresh recommendation signed by seven of the principal physicians of the city of New York, several of whom are Professors in our Medical Colleges. It appears as a newspaper advertisement, and the following extract will show that I do not magnify the extent of the evil:

"New York, March 13, 1862.

"UDOLPHO WOLFE, Esq.

"DEAR SIR,—We have tested the several articles imported and sold by you, including your Gin, which you sell under the name of *Aromatic Schiedam Schnapps*, which we consider justly entitled to the high reputation it has acquired in this country; and, from your long experience as a foreign importer, your bottled Wines and Liquors *should meet with the same demand.*

"We would recommend you to appoint some of the respectable apothecaries, in different parts of the city, as agents for the sale of your Brandies and Wines, where the profession can obtain the same when needed for medicinal purposes. Wishing you success in your new enterprise, we remain your obedient servants."

All this may seem to be hardly worthy of record, even in a *Note;* but it forms no small part of the history of the most remarkable revolution that has ever befallen practical medicine, and, moreover, the hope may be entertained that something may be thus contributed toward arresting the career of this wide-spread calamity. It also supplies a principal ground of solution for the disappearance of those remarkable efforts that had pervaded the United States for the suppression of intemperance.

Invasions upon certain obstinate conditions of disease not only plainly refutes the humoral interpretations of the modus operandi of cathartics in their peristaltic action and their effects upon disease, but it lays open the philosophy of the effects of *elaterium* and of other violent cathartics in sometimes subduing dropsical affections as set forth at p. 655–656, § 893 *n*, and which is there shown to have been explained "upon the principle of *counter-irritation*, or *metastasis* of the physical school," while, at the same time, a confirmation is thus obtained of the inflammatory nature of dropsical effusions, whether acute or chronic, as set forth among other facts in the Author's *Medical and Physiological Commentaries*, vol. i., p. 180–183, 186, vol. ii., p. 556, *note;* 1840. Also *Institutes*, § 892½ *k*, 892¾ *b*, *e*, *g*.

NOTE H.—NARCOTICS *versus* ANTIPHLOGISTICS.

NOTE H.—I have occasionally embraced opportunities of contrasting the substitutes for bloodletting in the treatment of inflammations and fevers which have been commended by those who are opposed to the latter remedy (§ 954 *b*, 960 *a*, *b*, 1005, 1006 *f*, 1068), and although the abstraction of blood is now very generally sacrificed to the *ad captandum* practice of tonics and stimulants, and all but animal nutriment is mostly proscribed, there has sprung up a *narcotizing* school whose excesses far surpass any former records of this kind of antiphlogistic treatment, and presents a doubtful alternative for the "tonic and stimulating plan." It seems to be proper, therefore, that these Institutes should be "posted up" upon the peculiar claims of the "opium treatment," and as these consist in effecting *narcotization*, my purpose will be sufficiently accomplished by showing how it is done—for the method is far in advance of the practice as it existed when the record was made in § 891 *c*. A greater importance has been also given to the subject by the accessions which have been made to the school from the influential ranks, and that this may be at once apparent, I shall have fulfilled the object of this note by presenting the following quotation from a writer of good repute, who has also quoted the statement from one of the most indulgent Commentators. The particular disease in the present instance was puerperal fever, but the same narcotizing treatment is applied to the common form of peritoneal enteritis. But, in the mean time, the inquisitive reader should refresh himself of the past by turning to § 1005. The first sentence of our quotation is from the text of Professor G. S. Bedford's late work on *Obstetrics* (1861), and the residue is embraced in an associated note. Thus:

"Professor Alonzo Clark, of the College of Physicians and Surgeons of this city, has employed opium in heroic doses during the prevalence of puerperal fever at the Bellevue Hospital, and with good success. Some interesting details furnished by Professor Keating, the able annotator of Dr. Ramsbotham, touching Dr. Clark's experience with opium in puerperal fever, will be found in Ramsbotham's System of Obstetrics, p. 534. I may here, however, be permitted to quote the following as an evidence of the extraordinary extent to which opium may be administered without fatal results. Professor Clark says: 'Regarding the tolerance of opiates in some of these cases—at the risk of being charged with rashness and trifling with human life—I will make some extracts from case seven. The treatment was commenced at 10 A.M., on the 26th of December, two grains of opium hourly. At 2 P.M., no change in the symptoms, dose increased to gr. iv.; at 3, gr. iv.; at 4, gr. v.; at 5, gr. v.; at 6, gr. viii.; at 8, gr. x.; at 9, gr. xij.; at 11, sol. morph. sulph. (16 gr. to f. ʒi.) ʒiss.; at 12, ʒi.; at 1½ A.M. (respiration 6), 0; at 6 A.M. (respiration 12), opium gr. xij.; at 10, sol. ʒi.; at 12 M., opium gr. xij.; at 1½ P.M., sol. ʒij.; at 2½, ʒij.; at 3½, opium gr. xxiv.; at 5, gr. xij.; at 6½, sol. ʒijss.; at 7½, ʒij.; at 9, opium gr. xiv.; at 10, gr. xvj.; at 11, gr. xviij.; 28th, at 1 A.M., sol. ʒijss.; at 2, ʒiv.; at 3½, opium gr. xx.; at 4, sol. ʒijss.; at 5, ʒiii.; at 6, ʒiijss.; at 6½, opium gr. x.; at 7, sol. ʒiijss.; at 8, opium gr. xxij.; at 9½, sol. ʒiv.; at 10, ʒiij.; at 11½, ʒiij.; at 12, 0. Thus this woman took, in the first 26 hours of her treatment, opium lxviij. and sulph. morph. gr. vij.; or counting one grain of sulph. morph. as four grains of opium, one hundred and six (106) grains of opium. In the second 24 hours, she took opium gr. cxlviii., and sulph. morph. lxxxj., or opium four hundred and seventy-two (472) grains! On the third day, she took 236 grains; on the fourth, 120 grains; on the fifth, 54 grains; on the sixth, 22 grains; on the seventh, 8 grains; after which the treatment was wholly suspended. This woman was not addicted to drinking, and, after her recovery, she assured me repeatedly that she did not know opium by sight, and had never taken it, or any of its preparations, unless

it had been prescribed by a physician. This is, perhaps, 'horrible dosing,' and only justifiable as an experiment on a desperate disease; yet this woman is alive to tell her own story, as are several others, who took surprising quantities of this drug. But later observations have shown that the tenth to the thirtieth part of this maximum is sufficient in controlling the disease'" (§ 960 *a*, 1064, 1065 *d*).

Although we may not hope to defeat the attempts to substitute other means for bloodletting, ranging from dry-cupping to tonics and stimulants, or consisting of the most violent poisons of the Materia Medica—aconite, tobacco, veratrum viride, opium, &c. (§ 960, 1065 *a*)—and where the abstraction of blood may be most demanded by the exigencies of disease, we may reasonably insist that the doses shall not be so large as to incur the penalties of the law were they administered by any other than professional hands. It was worthily said by Sigmond to his medical Class, that

"There is no doubt that any indiscretion in the use of violent remedies, any want of caution, may prove fatal; and notwithstanding the *occasional escape* of persons after the employment of fearful doses, I would impress upon your minds that you are never justified, because a *solitary case*, here and there, is *thrust* before your notice of extravagant quantities having been given, to administer, but with the remembrance of the sacredness of human life, any remedy which may have the slightest uncertainty in the intensity of its action. Nor do I think if any untoward event occurred in your practice from a very large dose that an excuse should be pleaded on the score that in some particular case such a quantity had been fearlessly employed, and fortunately no bad effects had resulted" (p. 720, § 960 *a*).—SIGMOND'S *Lectures* in London Lancet, December, 1837, p. 403, 404.

NOTE I.—REMEDIAL ACTION THROUGH THE HEART.

NOTE I.—In sections 500 *m*, 694¾, 826 *cc*, &c., I have represented the action of the heart when influenced by remedies as resulting generally from either their modifying effects upon disease and a consequent modification of the nervous influence thus reflected upon the heart, or from a simple modification of that influence generated by the direct action of the remedy upon the part to which it may be applied—either the gastro-intestinal mucous membrane or the skin—while in § 1065 *a* I have imputed the effect of certain agents, digitalis, colchicum, veratrum viride, in diminishing the frequency of the pulse to a narcotic virtue, and have objected to the therapeutical conclusions which have, in consequence, been predicated of those remedies. The latter are examples which illustrate the difficulties of medicine; for there can be no greater fallacy than the hypothesis that "remedies which lessen the frequency of the pulse are best adapted to inflammatory and febrile diseases." Every thing depends upon the mode in which the heart's action is influenced. To be significant of a salutary effect, whether the modified action consist in a diminished frequency or any other apparently favorable change, the influence must come especially through a salutary impression upon the parts diseased, if the heart have been disturbed by such affections; or, if such disturbance of that organ have not been thus inflicted, the modifying influence of any remedy upon its action, *per se*, is either useless or injurious, although a salutary effect of the agent upon any morbid process may simultaneously exert a modifying influence upon the heart's action. To be useful, therefore, the blow must be struck, not at the heart, but at those extreme vessels which carry on the morbid process (§ 410, 411, 639, 750, 999 *c*); and hence our conclusion, as expressed in the text (p. 860), that the substitution of veratrum viride, &c., for the abstraction of blood in the treatment of inflammation has grown out of very mistaken views in pathology and therapeutics. It is true, however, of some other remedies that diminish the frequency of the heart's action by their direct effect upon the gastro-intestinal mucous membrane, as small and frequently repeated doses of tartarized antimony, and jalap in cathartic doses (§ 516 *d*, No. 6, 904 *bb*, 1060, 1063 *b*), that this effect, which is in no respect due to a narcotic virtue, doubtless contributes to the salutary influence which is simultaneously and essentially impressed by the remedy upon the instruments of the morbid process, and which is indispensable to any lasting effect upon the heart's action if that organ have sustained any disturbance as a consequence of the malady (§ 500 *m*).

NOTE K.—EXCESSIVE MEDICATION BY QUINIA.

NOTE K.—To illustrate still farther the empirical nature of the practice of administering large doses of quinia in the treatment of intermittent fever (§ 892 *d–k*), as well as the fallacy of the humoral hypothesis, and to show the probability that such excessive medication must be injurious, as variously set forth in former sections (§ 675, 863 *d*, 870 *aa*, 900, 904 *d*, &c.), I shall introduce here the experience of Mr. Parkin, of England, who, in 1842, visited the South of France, where the intermittent fever was very prevalent and obstinate, and where some of the resident physicians were just beginning the treatment of the fever by the compound of quinia and carbonic acid gas; and it was particularly to witness the effects of this compound that the visit was made. The dose of the solution of sulphate of quinia along with the gas that was employed by Mr. Parkin was generally an ounce and a half, which contained much less than a grain of the sulphate of quinia. The largest doses had only a grain and a half. His success was so remarkably great that in the following autumn he went to Madrid for the same purpose, where the Minister of the Interior assigned to him a ward in the General Hospital of that Capital to carry on his experiments, and here he was equally successful with the moderate treatment as he had been in the South of France. But it was not only by small doses of the alkaloid that he accomplished his cures, but often by a single dose. And now observe how his critical experience as to the most useful time for administering the dose contradicts the humoral hypothesis, both as to the pathology of the disease and the modus operandi of the remedy, and establishes my interpretation of the latter through reflected actions of the nervous system. "The result of these trials," says Mr. Parkin, "confirm me in a conclusion I had previously formed as to the *proper time* for the administration of the remedy, which I found to be *immediately before* the accession of a paroxysm. When thus administered, I have generally found that it shortened the paroxysm, and that it arrested it altogether, upon the average, at the third administration of the remedy. The same result was experienced in old as in recent cases, even where the disease had existed twelve months. There were numerous cases in which no return was experienced after the first administration of the remedy, while in some cases the expected attack was not experienced at all."*—LONDON LANCET, April 29, 1843, p. 139.

That the remedy should be administered at some period of the intermission, and suspended during a paroxysm, has been always regarded as an indispensable rule of practice (§ 675); but in the case of the particular compound now before us, it was found by a critical observer that the most appropriate time was circumscribed within a few minutes. Now, if the doctrine of operation by absorption had any foundation —whether the remedy be supposed to neutralize or extinguish some poison assumed to exist in the blood, according to a large school, or to unite chemically with the solids, according to Liebig and his followers (p. 171, No. 42),—the remedy if administered during the hot stage of a paroxysm of intermittent fever should not as uniformly aggravate and prolong the disease as it arrests its career when administered during the period of intermission (§ 675), and least of all should it be most salutary if given at the precise moment indicated by Mr. Parkin.†

I have illustrated the influence of *vital habit* by a reference to the periodical return of an intermittent fever through a series of years, notwithstanding the early removal of the subject from a miasmatic region to a climate entirely exempt from intermittents (§ 560); a fact which, in itself, disposes of the whole question before us, whether it respect the assumed absorption of a poison, its continued presence in the system, or the humoral interpretation of the modus operandi of the remedy. Analogous facts abound in the history of diseases, and are worthy the consideration of those who aspire at the realities of Nature, and would escape the seductive simplicity of the substitutions of art (§ 506, 526 *c*, 657 *a*, 826 *b*, 828 *a*). Again, also, in all our reasoning upon these leading principles in the philosophy of medicine, we should not neglect, in connection with the foregoing subject, the minuteness of the quantity of quinine that may be sufficient to arrest a very violent and protracted fever (§ 870 *aa*); and the same may be alleged of the arsenical preparations.

* The following is the formula employed: ℞ Sulphate of quinia, grs. xvi.; tartaric acid, grs. lx.; bicarbonate of soda, grs. lxxv.; water, ibij. The alkaline carbonate is added last.

† See corresponding evidence and philosophy of the subject at p. 430–432, § 675; p. 548–549, § 863 *d*; p. 597, § 892 *c*; p. 739, § 987

NOTE L.—MODUS OPERANDI OF ARSENIC AND ANTI-PERIODICS.

NOTE L.—As to the modus operandi of arsenic (§ 892¼ *g*), it is readily seen from the mineral nature of the substance that it cannot exert the same effects as the vegetable substance Peruvian bark, no more so than does the animal product, spider's web, in doing the same thing, exercise the influences of either, no more so than when an emetic, or a strong mental emotion, or loss of blood, suddenly breaks up the same condition of disease. And yet the chemist has the singular infelicity to tell us that all this medley of things cures intermittents equally either by their chemical union with some imaginary poison in the blood, or by forming new compounds with the solids; which is equivalent to saying that arsenic and cinchona and spider's web (neglecting emetics and mental emotions and loss of blood) will as readily unite with each other as acids do with alkalies (§ 675, 863 *d*, 870 *aa*, 892 *b–k*, 900, 904 *d*, 986).

The vital solidist, in rejecting the chemical rationale, may briefly reiterate the philosophy which he would substitute—that each agent has its peculiar virtues, exceedingly unlike where they are most curative (as cinchona, arsenic, and spider's web), and each exerts its own peculiar changes in the morbid states, places them in other conditions less intensely morbid, and thus enables the physiological laws to institute the restorative process (§ 854, 900, 902 *h*, 904 *bb*). No matter, therefore, whether arsenic be administered in simple intermitting fever, or as that disease may be complicated with chronic cutaneous eruptions, when the impression is made which enables the great recuperative law to throw off the fever, the same artificial change may equally induce, through the same constitutional principle, the disappearance of the chronic affections of the skin (§ 902, 1059).—NOTE R p. 1123.

Again, that the constitutional effects of arsenic depend upon its primary action upon the alimentary mucous tissue and the subsequent development and reflection of an alterative nervous influence may be distinctly shown by the remarkable contrast in the phenomena and pathological conditions that are induced in different individuals by poisonous doses. It is well known that the symptoms are generally those of violent gastro-enteritis, but that there are rare instances in which the symptoms are such as are produced by poisoning with opium. Of these exceptions, which form a most imposing contrast with the more numerous class of cases, there has occurred in my practice one strongly marked example, in which vomiting was effected with difficulty by emetics, and which would have been mistaken for poisoning by opium had not the nature of the cause been known from the beginning. About an ounce of the white oxide of arsenic had been swallowed, and large quantities of it were thrown off from the stomach. Death took place in about twelve hours. Lethargy came on early, and was very overpowering. No gastric uneasiness or purging. Respiration became very slow some six hours before death, accompanied by a very irregular pulse, varying from twenty to fifty beats in two successive minutes, but not intermitting. The action of the heart was strongly affected by the respiratory movements, which were without any uniformity. They would be suspended for several seconds, and then would follow a long and deep inspiration; and of these movements there were from three to six in a minute. During the suspension the pulse would sink down to its lowest frequency, and when inspiration took place the pulse would suddenly bound from 20 to 40 or 50 strokes, and become much increased in volume. The case being obvious, the distress of the family rendered it inexpedient to request an examination after death. But *post mortem* examinations have been made in other analogous cases.

The principal remaining point to be observed in the two series of cases is the correspondence of the cadaverous appearances with the phenomena during the action of the poison, and it shows that the difference in the local and constitutional symptoms, in the opposite cases, is owing to the different modes in which the gastro-intestinal mucous membrane is affected by the poison; since it exhibits in one series of cases the most positive signs of inflammation, while in the other, or form of narcotic poisoning, no morbid condition of the stomach at all resembling inflammation is apparent on dissection (§ 512, 826 *cc*, 841, 902, 904 *bb*).

NOTE M.—MODUS OPERANDI OF ANÆSTHETICS.

NOTE M.—In speaking of the modus operandi of chloroform and sulphuric ether when respired, I adverted to the difference in their effects when employed in that

manner and as administered by the stomach (p. 864, § 1066 *b*), and intended to imply that such a difference should not obtain if these agents operate through the medium of the circulation. They should not manifest the effects simply of a diffusible stimulant in one case and of an anæsthetic in the other; for, whether absorbed through the mucous tissue of the lungs or of the stomach, or whether the supposed intermixture with the blood take place in the pulmonary air-cells or at the junction of the chyliferous duct with the subclavian vein, there can be no difference as to the impregnation of the blood, which is the essential fact in question. But a ready explanation of the difference in effects will be found in the vast difference between the vital constitution and functions of the mucous membranes of the stomach and of the lungs, and in the well-known diversity of effects that arise from a thousand causes as they may be introduced into one organ or the other (§ 133–137). Each cause exerts special but different effects upon the mucous membrane of either organ respectively; and according to those effects the nervous influence will be developed and modified in a corresponding manner, and, by its reflection upon other parts, will exert upon them effects corresponding with the primary impressions, as variously expounded in this work.

Again, if it be true, according to Lallemand, that "ether, chloroform, and amylene are absorbed and act first in a direct manner on the brain and other nervous centres, where they *accumulate*, and are, as it were, *stored up*, and that, secondly, they afterward proceed to act upon the blood," there should not be, under such circumstances, any necessity for the uninterrupted respiration of anæsthetics to maintain insensibility, nor any sudden subsidence of the anæsthetic influence. But the facts establish an evanescent effect conformable to superficial impressions of a very transitory nature, which as suddenly and transiently rouse the nervous influence, while they equally and as plainly contradict the hypothesis of "*accumulation* and *storing up*" (§ 827). Finally, the *volatility* of these agents is against the doctrine.

NOTE N.—DIGESTION NECESSARY TO NUTRITION.

Note N.—If it be admitted that alcohol, sugar, animal broths, &c., enter the circulation unchanged, it is impossible that they should be tributary to nutrition, since that unique, homogeneous substance the blood can alone fulfil this great ultimate object of the elaborate system of organs which is designed for the formation and *vitalization* of that fluid, and towards which the first and indispensable step is a positive change instituted in all nutritive matter by the gastric juice, while the kidneys are placed at the other extremity of the series in part for the removal of any matter which may have escaped the organizing influence of the chylopoietic organs. Hence, the application of butter, &c., to the skin, and that most plausible of all devices to sustain the body, enemas of animal broths, must be regarded as fallacious (p. 171, 172, § 350, Nos. 41, 42, 43, 94; p. 222, § 409 *b*; 440 *bb*, 441 *c*; p. 790, § 1032 *b*).

NOTE O.—CEREBRAL CIRCULATION.

Note O.—In confirmation of the conclusion from my experiments upon the brain that the quantity of blood circulating within the organ has been much overrated, it should have been said in the text at page 826 that both carotids have been successfully tied in the human subject, at an interval of a few days for each carotid, without injury to the cerebral functions. In some animals, as the rabbit, the same operation has been performed simultaneously upon both carotids and one vertebral artery without injury to the brain.

NOTE P.—EXAGGERATIONS OF INSTINCT.

Note P.—If the following statement has not been made as an illustration, merely, of the propensity to magnify the endowments of Instinct, it was designed not only to ascribe the rational faculty to animals, but, in presenting a case of *dishonesty*, to impute to them the *moral sense* or *conscience* (§ 1078 *h*, *l*). It is derived from Dr. John Brown's veracious *Horæ Subsecivæ* (vol. ii.):

"Mr. Carruthers, of Inverness, told me a new story of these wise sheep-dogs. A

butcher from Inverness had purchased some sheep at Dingwall, and giving them in charge to his dog, left the road. The dog drove them on till, coming to a toll, the toll-wife stood before the drove demanding her dues. The dog looked at her, and, jumping on her back, crossed his forelegs over her arms. The sheep passed through, and the dog took his place behind them and went on his way."

NOTE Q.—PARAPLEGIA AND REFLEX NERVOUS ACTION.

NOTE Q.—In expounding the causes of a form of paraplegia which Dr. Brown-Séquard denominates reflex, in his recent "Lectures on Paralysis of the Lower Extremities" (1861), several principles are recognized that are tributary to some of the important doctrines of these Institutes. The Author supposes, for example, that affections of internal organs will not only induce a congestive state of some portion of the spinal cord that will lead in a direct manner to paralysis of the lower extremities, but that at other times they will propagate a morbific influence through sensitive upon excito-motory nerves, and thus occasion "a contracted or spasmodic condition of the blood-vessels of the spinal cord, unaccompanied by actual structural alteration," which results in paralysis of the lower extremities. Although it be true that the supposed contraction of the blood-vessels cannot be anatomically shown, but is inferred from the absence of morbid vascularity in connection with an experiment to be soon mentioned, and although I apprehend that the supposed contracted state of the blood-vessels, if founded in fact, is no more occasioned by reflected nervous influence than the simply congested ones in the other series of cases, and that they are on common ground throughout, in a physiological sense, as sources of paralytic influence, I present the problems not only as admitted exemplifications of the production of spinal disease by morbid states of internal organs, but as introductory to a demonstration by our able physiologist of the local and special influences which are exerted upon the blood-vessels of the spinal cord by irritations of distant organs, particularly the kidneys, through which the vessels may be brought into a state of contraction, and that the cord thus artificially affected may exert a paralyzing effect upon the lower extremities. The following is the demonstration:

"A contraction of the blood-vessels in the pia mater of the spinal cord I *have seen* taking place under my eyes when a tightened ligature was applied on the hilus of the kidney, irritating the renal nerves, and when a similar operation was performed on the blood-vessels and nerves of the suprarenal capsules. Generally, in these cases the contraction is much more evident on the side of the cord corresponding with the side of the irritated nerves, which fact is in harmony with another and not rare one as regards the kidney, and often seen by me after the extirpation of one kidney, or one suprarenal capsule, that is, a paralysis of the corresponding lower limb."

The novel and interesting fact in the foregoing quotation consists in the influences which were *actually seen* to have been exerted upon the blood-vessels in the spinal cord by irritations of organs remotely situated, and the corroborating light which is thus reflected upon the philosophy inculcated in these Institutes concerning the transmission of influences to and from the nervous centres, whether brain, spinal cord, or ganglia and plexuses of the sympathetic system, through which I have interpreted not only the diseases which follow consecutively upon each other, but the modus operandi of morbific and remedial agents, and have thus endeavoured to demonstrate the artificial and fictitious nature of the entire fabric of humoralism. Even Brown-Séquard argues from his experiment, especially, that reflex paraplegia is occasioned by "a contracted or spasmodic condition of the blood-vessels of the spinal cord, owing to an irritation reflected upon their walls, and originating from without, unaccompanied by actual structural alteration." Such may or may not be the immediate cause of the paralysis; but that influences upon the vascular system of the brain, and upon the cerebral substance, are constantly exerted by remote affections and by morbific and remedial agents, is corroborated by most of the phenomena that are presented throughout the vast fields of pathology and therapeutics. So obvious is all this, and such are the special developments and modifications of the nervous influence, and such, accordingly, are its effects in organic life, that I have imputed much of the depressing effect of loss of blood to a contraction of the cerebral vessels as contributing to the development of that depressing nervous influence which is so largely concerned in the operation of loss of blood (§ 942, 950, p. 827, § 1056), and, on the other hand, the resistance of its effects to a stimulating nervous influence arising from an excited state of the cerebral blood-vessels in inflammations of the brain and of other organs (§ 233¾, 974, p. 828, § 1056, DONDER).—NOTE T p. 1125, WARREN'S case. Also, p. 920, NOTE.

NOTE R.—REMEDIAL ACTION, CHEMICAL DOCTRINE.

NOTE R.—Chemistry, as we have seen (p. 171, § 350, Nos. 41, 42, &c.), informs us that remedial agents accomplish the removal of disease by uniting either with the solids or the blood, or by neutralizing some poison supposed to be intermixed with or contaminating the blood, or by expelling the poison from the body, &c. Without having called upon Chemistry for the proof of these assumptions, I have shown that they are variously contradicted not only by the whole history of remedial action and the soundest principles in pathology, but by the logical facts of Chemistry itself. Among the multitude of the former nature the consideration alone of the variety of things which will quickly subdue an intermittent fever (cinchona, arsenic, spider's-web, opium, an emetic, blood-letting, mental emotions, &c., § 900, 986–988, NOTE L), is demonstrative of the fallacy of the entire compass of the chemical rationale. Nevertheless, it is my purpose in this Note to add a few words of comment upon that branch of the doctrine which assumes that remedies unite chemically with the blood or with the solids, and that they thus transmute the morbid into healthy conditions. This is Liebig's philosophy, and obtains extensively in the medical ranks. It has the air of science upon its front; but it is as unmitigated an assumption as the doctrine of the permeation of tissues set forth in § 350½ *n*, and is contradicted by the realities of Chemistry. Take, as an example, the statements quoted at p. 171, Nos. 41, 42, from Liebig's "*Animal Chemistry.*" What possible apology, derived from the domain of chemistry, can be offered for the proposition that—"if, by the introduction of a substance, certain abnormal conditions are rendered normal, it will be impossible to reject the opinion that this phenomenon depends on a *change in the composition* of the constituents of the diseased organism, a change in which the *elements of the remedy take a share* in the formation of new or transformation of existing compounds *similar to that which the vegetable elements of food* have taken in the formation of *fat, of membranes, of the saliva, of the seminal fluid,* &c."!

The foregoing assumption derives its importance from the general currency which it has obtained in the medical profession. Upon this dictum have been founded the enormous abuses of iron in the treatment of pulmonary consumption, anæmia, chlorosis, &c., and, indeed, the general administration of remedies, whether they consist of elementary substances, like iodine, or of inorganic or organic compounds, some of which (as the phosphate of iron) have obtained the name of "*chemical food.*" Iron, particularly, is supposed to meet, in this way, the exigencies of an endless train of the most dissimilar maladies, on account of its assumed deficiency in the blood and of its uniting readily with the globules. But it is remarkable that it appears not to have been considered that nothing but food, properly so called, undergoes digestion, certainly not inorganic substances, nor the organic of the Materia Medica, and that without antecedent digestion by the chylopoietic organs every thing which gains admittance into the circulating mass of blood must fail of being appropriated to any useful purpose, and must necessarily exist in the same isolated, inanimate state till it is ejected by the emunctories.* If it exert any therapeutical effect it can be only through its direct action upon the solids as a foreign agent (§827 *f*, 904 *c*). We have seen that even saccharine matter (p. 788–790, § 1032 *b*), broth, even (NOTE N, p. 1121), to be appropriated must be digested, vitalized, subjected at least to the gastric juice before they enter the circulation. Otherwise, they are effete matter. Whether, therefore, regarded as nutriment, or other things as remedial agents in virtue of their "elements taking a share," &c., as quoted above, the doctrine, now in the ascendant, is alike discreditable to medicine and to chemistry (§ 13, 17, 353, 354, 360, 837, 847 *a*).

And now a few words more particularly as to *iron*, which, like alcoholic liquors, quinia, and opium, has become a panacea. Strangely enough, this substance, whether in the form of an element, or of its compounds, is supposed by chemists as well as physicians to unite as readily with the blood as oxygen gas, while there is no analogy in the cases, either as it respects the chemical aspect of the subject, or the organs provided, respectively, for their incorporation with the blood—being the peculiarly constituted lungs in the one case (§ 447½ *e*, 827 *b*), and a very complex and elaborate system of organs in the other (§ 353, 354). The only possible mode in which iron can become united with the globules of blood is through its connection with organic compounds, duly digested and vitalized by the whole labyrinth of the chylopoietic organs (§ 17, 360), and its presence is limited to the blood alone

* Contrary, therefore, to general belief, WATER is in no respect appropriated, but merely serves to dilute the blood. See § 271, 419 *c*, 827 *b*, 1088 *b*.

(§ 447½ *a*, No. 1). Whatever benefit, therefore, iron bestows either upon the blood or the solids can be interpreted only upon the principles of vital solidism,—alone by improving the functions of digestion. Iodine, lime, all the elements of the body, observe precisely the same rule as to their incorporation with the blood or with the solids, while it is just the reverse with plants (§ 11, 14, 17, 360). It is among Liebig's enlightened statements that iron exists in the blood in the state of an "organic compound" (§ 447½ *a*), and as this is truly its condition it operates as a farther confirmation of the foregoing physiological doctrine.

NOTE S.—TYPHUS AND TYPHOID FEVER.

NOTE S.—But little is said specifically of *typhus* fever in these Institutes, and that little occurs mostly in sections 686 *b*, 892 *q*; but in the *Medical and Physiological Commentaries* the subject is discussed extensively, particularly in the articles upon the Medical "Writings of Louis," and upon the "Philosophy of Venous Congestion" (vol. 2). In these Essays the Author has shown that there is no such affection as *typhoid* fever as distinguished from *typhus* fever (an opinion, also, of the best informed), and that this disease does not originate on this continent south of the latitude of about 41°. The Author, who became familiar with typhus fever during his pupilage in Boston, and was extensively concerned with it in Montreal during the first five years of his professional life, is enabled to say very confidently that the disease is of rare occurrence in the city of New York and surrounding country, and only so where the predisposition has been contracted in a more northern latitude. Such, too, is the testimony of able and long established physicians in this city, as recorded by the Author in the Essay on the "Philosophy of Venous Congestion" (*Commentaries*, vol. 2, p. 449–451, *note*). The following quotation from that work affirms the same of places still farther south:

"The hospital of Philadelphia has furnished many instances of typhoid or typhus fever; but we infer not only from the foregoing facts that they were either imported cases, or derived, as in the sporadic cases of our own hospital, from cellars, &c., but from the long experience of the distinguished Dr. Dewees, of that city, who remarks that he '*has never had an opportunity of seeing a case of typhus, although*,' as he says, '*we hear constantly of this disease*, and our bills of mortality never fail to record deaths from this fever.'—DEWEES' *Practice of Physic*, p. 170, 171. And so Dr. Davidge, in his edition of Bancroft on Fever, &c. (p. 518), 'Typhus,' he says, 'is not, so far as my observation has extended, a disease of Maryland, perhaps not of America, at any rate not south of the New England States.' 'Typhus,' says Bancroft, 'is properly a disease of cold climates' (*ibid*, p. 342). John Hunter considered it a disease of winter. 'Heat,' he says, 'proves a prevention to the disease as much as cold forwards its production.'—LONDON *Medical Transactions*, vol. 3, p. 348. The same statements are made by Blane, Lind, and Trotter, in their respective treatises on Scurvy, &c."—MEDICAL AND PHYSIOLOGICAL COMMENTARIES, Vol. 2, p. 450.

As to Louis's distinction of "*typhoid*" from *typhus* fever, I have shown it, in each of the foregoing Essays, particularly in the analysis of the "Writings of Louis," to be simply a fiction. So far as the celebrated Parisian malady had any affinity to typhus fever it was purely typhus. I shall, therefore, without farther preface, proceed to say—partly in defense of the ground which I have hitherto taken upon the subject, and partly on account of the mortality attendant upon the disease—that the so-called "typhoid" or "typhus fever" that has prevailed as a most fatal epidemic among the hosts of the federal and rebel armies during the last fourteen months (now September, 1862) is the common *congestive*, *bilious remittent fever*, but which is made to put on some of the worst symptoms of typhus fever, (such as delirium and subsultus tendinum), by the general treatment of the affection, (with some distinguished exceptions), from the very outset, by tonics and stimulants, of which "Bourbon whisky" (p. 1116, *sub-note*), and quinia in potential doses (§ 892 *d*), are prevailing favorites. For the purpose of informing myself as to the diseases of the federal army, from their earliest to their advanced stages (the latter of which now abound in the hospitals of New York), I visited the principal encampments, and was in constant intercourse with the sick during the latter part of July, the whole of August, and the former part of September, 1861, at the large and numerous hospitals in and around Washington, and the regimental hospital tents, and,

also, similar rendezvous of the sick at and about Fortress Monroe. These hospitals and tents were thronged with the subjects of intermittent and remittent fever, but I saw not a case of typhus fever, and recognized in every case of the so-called "typhoid fever" the familiar *remittent*, the usual companion of the intermittent, generally mild at its invasion, but apt to be soon aggravated and often rendered fatal by the tonic and stimulating treatment. Such was much of my experience with the "Army of the Potomac;" but not so with the fewer troops then at Fortress Monroe and its vicinity, where the antiphlogistic practice mostly obtained; and although the fever was identical with that of the vast army in the region about Washington, the mortality was very slender, and limited to the stimulating practice. Here I saw patients affected with the reputed "typhoid" restored in twenty-four to forty-eight hours by an emetico-cathartic of calomel and ipecacuanha. This was as late as September. The contrast between the two methods was very impressive.

"The regular correspondent" of the New York "Evening Post," in a communication dated Washington, January 10th, 1862, remarks that—"there is here an immense number of cases of the so-called typhoid fever. The peculiarity of this fever, as it is developed in the vicinity of Washington at the present time is, that it is of a malarious type and origin, so that if treated as a malarial fever it soon succumbs, but if treated as an ordinary type of the typhoid fever it is very fatal."

Nor can I refrain from alluding to an experiment which has been extensively made in the army of employing quinia, and "Bourbon whisky" or brandy, as prophylactics. In the *Medical and Physiological Commentaries* I have inquired into the history of prophylactics, as exemplified particularly in the use of calomel to the extent of salivation, blood-letting, and stimulants, the first two of which have been tried upon an extensive scale, especially upon armies invading the West Indies, when it was found that loss of blood lessened the susceptibility of the system to the causes of the prevailing fever, besides, doubtless, counteracting the stimulating effect of the ardent heat of the climate and of the animal food. In another instance Robert Jackson illustrated the principle under consideration, and set forth triumphantly the medical aspect of temperance, by banishing alcoholic liquors from the British Army (p. 396, § 621 *a*, 659 *b*, 692 *b*, *c*, 999, 1006 *c*—1008, 1065 *c*, 1068 *a*).—The reverse of all this has attended the stimulants when employed as a protective means, having operated not only as subordinate predisposing causes by rendering the system more susceptible to the action of the miasm or essential predisposing cause, but also as exciting causes (§ 630 *e*, 787, 801, 810, 813, 815, 961).

NOTE T.—SYMPATHETIC OR REFLEX NERVOUS ACTION.

NOTE T.—The following instance of reflex nervous action corresponds with the experiment of reducing the temperature of one hand by placing the other in cold water, as related in section 1044 *a*, and with the well-known sense of itching, &c., that springs up as a sympathetic consequence of a similar sensation in the corresponding part of the opposite side of the body. Thus—"A singular case is noted in the Cairo military hospital (December, 1861), of a man who was shot in the right leg and had it amputated. Sympathetic action took place at once in the other limb, and at precisely the same part where the knife had severed its fellow a similar pain was felt. So severe did this become that the leg is bandaged and treated as if itself wounded."

For the purpose of showing the inherent power of action in the arteries, and how that action is excited and otherwise influenced by the nerves, and how that influence may be exerted through the reflected process, and how, also, the reflex nervous influences are remarkably displayed in corresponding parts of opposite sides of the body, and forming, moreover, a good example of continuous sympathy, I introduced the following case into the *Medical and Physiological Commentaries* from Warren's "*Surgical Observations on Tumors.*"—Thus—"In a case where Dr. Warren tied the right carotid on account of an erectile arterial tumor situated at the internal angle of the right eye, this vessel and its opposite fellow and their branches pulsated with violence. The ligature on the right carotid removed the pulsation of the left, although 'the vibrations were more conspicuous on the left than on the side originally deranged.' 'The perfect success, from tying the right carotid, showed the affection was altogether sympathetic'" (p. 827, 1056, p. 920, *note*).—MED. AND PHYS. COM., Vol. 2, Article, *Theories of Inflammation*, p. 149—1840.—See NOTE Q. This well

known disposition of the corresponding parts of opposite sides of the body to sympathize with each other has its foundation, of course, in an identity of anatomical and physiological constitution, which is very well shown by the following case of purpura-hemorrhagica, occurring in my practice, and recorded in the Essay on the "Philosophy of Venous Congestion," in MED. AND PHYS. COM., Vol. 2, p. 473. The case was introduced there for the purpose of showing the active, inflammatory nature of purpura-hemorrhagica, in opposition to the humoral pathology, and to exemplify the beneficial effects of blood-letting in that affection (§ 1002 *d*).—Thus the Commentaries—

"The patient having passed a few months on the alluvion of the Mississippi was attacked on his return to New York with an irregular intermittent fever. In its early stage a general extravasation of blood took place over about one half of the posterior part of each humerus, occupying in each arm the *central part*. The *inferior portion* of the lobe of each ear was distended with extravasated blood, and just *at the middle* of each helix was another narrow oblong extravasation of about half an inch. A similar appearance existed in the conjunctiva of each inner canthus of the eye. There was not a trace of any effusion in any other part, or from any of the internal membranes. The parts where it existed were very tender to the touch. There were obvious signs of hepatic congestion. A large abstraction of blood immediately arrested the effusion, and improved at once the strength of the patient, who soon became convalescent. The symmetrical peculiarity of this case is worthy, also, the consideration of the humoral pathologist" (§ 1002 *d*).

NOTE U.—CONTINUOUS SYMPATHY, OR CONTINUOUS INFLUENCE.

NOTE U.—Continuous sympathy, unlike reflex nervous actions, does not involve the agency of the nerves excepting as they are an elementary part of the compound tissues; but the impressions resulting from continuous sympathy or continuous influence are constantly giving rise to reflex nervous actions in organic life. This, as already briefly stated, is distinctly seen in the action of suppositories, enemas, leeches applied to the anus or to the septum nasi, croton oil applied to the tongue, &c. (§ 129 *c*, *f*, 498, 516, No. 2, 828 *d*, 923 *d*). The examples embraced in the foregoing sections are intended to illustrate the subject through impressions made upon the intestinal mucous tissue, and, therefore, there should be associated with expositions of this philosophy the consideration that peristaltic motion, in the natural state of the body, is excited immediately by the action of the nervous influence upon the intestinal muscular tissue (§ 233⅘, 475½, 490, 514 *f*, &c.).

As some important principles in medicine are involved in the foregoing philosophy, whether continuous influence be regarded in its abstract sense, or as instituting reflex actions of the nervous system; and for the sake of having the whole philosophy of the subject before us in this Note, and with reference to what I am about to say of rhubarb, I shall recapitulate, in a few words, some of the expositions already made. Croton oil affords a clear illustration, as it exerts a cathartic effect without entering the stomach, as when applied to the tongue of an apoplectic subject, or when introduced into the rectum in the quantity of a drop. The impression exerted upon those places is propagated continuously along the mucous tissue (§ 498), and this, being equivalent to the direct passage of a cathartic, establishes early an alterative reflex nervous action which falls upon the muscular tissue of the intestine, and thus induces purging, and upon various other parts according to their existing susceptibilities, the activity of the agent, &c. Suppositories and enemas observe the same rule, whether they be stimulating, irritating, sedative, anodyne, soporific, &c., the reflected nervous action being modified according to the nature of the exciting cause (§ 889 *a*, *b*, *g*, 890½ *d*, 891½ *k*, 893 *a*). So, also, of leeching, as expounded in sections 498 *f*, *g*.

The foregoing retrospect contemplates among its purposes a confirmation of the philosophy by the action of rhubarb, and a demonstration through that action of the physiological operation of cathartics as distinguished in these Institutes from the doctrine of operation by absorption. It may be very briefly stated. If a little rhubarb be chewed when a cathartic is about taking effect, it will often very sensibly increase the peristaltic movements within a few seconds, and without being swallowed; the mouth itself being a point of departure for the reflected nervous influence. Doubtless the same is true of some other cathartics.

NOTE W.—AMERICAN MEDICAL PROFESSION AND GREAT BRITAIN.

Note W.—Perhaps in consideration of what the Author has said at page 460 of the superiority of the American over the European Medical Profession, it is but fair that the opposite side should be permitted to speak through these Institutes, according to the Author's usage; and this may be done emphatically by an extract from an article lately published by the Author which embraces the opinion of the leading medical Journal of Europe. Thus—

"It is time that a greater interest should be manifested for our own medical literature—not a whit behind that of Great Britain, which has hitherto contrived to over-ride our own. We have permitted ourselves to be whipped into this ignominious condition—allowing all that may be due to the jealousies of domestic competition; and that there is no relaxation of the systematic discipline from abroad, or of our submission to it, we are assured on turning to the Review of Professor Gross' late 'American Medical Biography,' in the July (1861) number of an American edition of the *British and Foreign Medico-Chirurgical Review*, in which, after a profusion of ridicule of what it denominates the 'biographers and the biographees,' and a characteristic John Bull hit at '*the Union now in process of disruption*,' it is said, as a final and summary conclusion, that, '*We shall be sorry if it is ever our lot again to meet with an American Medical Biography.*' This very Journal, too, which never spared what is able in the medical literature of these United States (but only what is ephemeral), notwithstanding its republication and support for near half a century by those whom it maligns, now, taking counsel of the past and encouraged by the hope that 'the Union is in process of disruption,' would not only extinguish our '*dii immortales*' and all their contributions to a Nation's best wealth, but *the very Nation itself.*" P.S. The republication, I regret, is discontinued.

NOTE X.—RIGHTS OF AUTHORS.

Note X.—When the Author was speaking, in his reclamation, of the agency of the nervous system in the production and cure of disease, at page 916, and as set forth by himself in his "Essay on the *Modus Operandi of Remedies*," published in the year 1842, and taught annually from his professorial chair from that day to the present (1862), it would have been, perhaps, more satisfactory to the reader had the Author stated that all that is embraced in the Institutes (first published in 1847), between sections 896 and 905 *b*, inclusive, and extending from page 662 to 681, is a literal transcript of the "Essay on the *Modus Operandi of Remedies*," published in 1842, which, of course, comprehends the Author's philosophy of the operation of *counter-irritants* as expounded in § 905 *a*, being the example of the *seton*.

But, in a reclamation so important and comprehensive as the Author's, it may be still more satisfactory to those who have not a ready access to the "Essay" should the Author recite an example from the "Essay," that it may be compared with the corresponding part of the Institutes. Take, then, as a continuous example, section 902 *d* to section 902 *l*, inclusive, of the Institutes, and the Essay from p. 44 to p. 49. Thus the Essay—

"The examples of sympathetic influences, through the *reflex action* of the brain and spinal cord, are almost endless, as they also are in every part of the animal organism. They supply the most ample ground for the interpretation of the effects of remedial and morbific agents in their wide range of influences. The modifications of the circles of sympathy which relate to the respiratory system alone, as in coughing, crying, laughing, yawning, &c., are a fruitful field of inquiry into great and precise laws, and extensively applicable to the philosophy of medicine. The only difference is, that, when disease is established in a part, or when remedial agents operate, the organic properties of the part are altered in their nature, and, of course, the organic actions over which they preside. A specific impression, in the latter cases, is transmitted to the cerebro-spinal axis, and from thence *reflected* through other nerves upon the organic properties of other parts, and, according to its nature, disease will be produced or mitigated in those parts. However complex and variable, therefore, the phenomena, nothing can be more simple than the principle through which all these changes are produced.

"When an emetic operates, the philosophy of its influences is the same as that which relates to respiration, &c. The impression upon the stomach is transmitted to the brain and spinal cord through the pneumogastric and ganglionic nerves, the nervous power developed and *reflected* in the foregoing manner *upon the respiratory nerves*, while another current descends along other fibres of the pneumogastric to the muscular tissue of the stomach. If the emetic operate, also, as a cathartic, then a new chain of actions is established, in the same way, in the abdominal muscles, while a current of the nervous power is propagated upon the muscular coat of the intestines.

"But, in the foregoing case something more happens than in the natural processes. Here the exciting cause possesses peculiar virtues, is of a morbific nature, and it not only makes peculiar impressions upon the alimentary mucous tissue, according to the exact nature of its virtues, but it modifies the nervous power in a corresponding manner. If the stomach be the seat of disease, the direct impression upon that organ, or the change which an emetic may effect in its vital condition, will be more or less varied from what is exerted in a state of health. It may, therefore, prove curative to the stomach by this direct influence. But the nervous power is also modified according to the impression produced upon the organic properties of the stomach, and is sent abroad, with alterative effect, upon various parts of the system. According to a law by which diseased parts are far more susceptible of influences from vital stimuli than such as are not diseased, the modified nervous power will fall with far greater effect upon the former than the latter. The organic properties and actions of one may be profoundly and permanently affected, while the latter are only moderately and very temporarily influenced. In consequence, also, of the deep effect which the modified nervous power exerts on the diseased parts, they may return, at once, to their natural state.

"But the milder influences which are set up by the nervous power upon parts in health, or in comparative exemption from disease, play, also, their part in the salutary process. If the emetic operate also as a cathartic, impressions are transmitted from the intestinal mucous membrane to the cerebro-spinal system, the nervous power developed and modified according to the nature of these impressions, and radiated abroad as when the result of the action of the emetic upon the stomach, and with effects corresponding to this new development and modification of the nervous power.

"Again the skin is influenced in the foregoing manner, and this organ transmits that impression to the cerebro-spinal axis, and develops and modifies the nervous power accordingly, when it is, as in the other instance, *reflected* abroad, and is felt by various parts according to their degrees of susceptibility. Various other circles of sympathy of the *same nature* set in, and become too complex for analysis; but all may fall with one concurring, curative effect upon the diseased susceptible organs.

"We thus see that when vomiting springs from the operation of tartarized antimony, and often from ipecacuanha, it is only one of the consequences, and a minor one, of the peculiar irritation of the gastro-mucous membrane. Other and far more powerful influences are determined, simultaneously, upon the organic properties and actions of distant and diseased parts (perhaps as distant as the most remote extremity), by the same nervous power that shook the respiratory organs during the act of vomiting. And often, indeed, does it happen that those influences are propagated with the most profound effect when the act of vomiting fails of being consummated; and nausea alone shall send with *prostrating effect the modified nervous power* over the whole system; when we shall see *it simultaneously bathing the whole surface with perspiration; pouring the saliva from the mouth; breaking down a tumultuous excitement of the heart and arteries; starting on the instant a torrent of bile, and an equal effusion from the intestinal mucous membrane;* and at the next moment, calling up a magnificent play of reflex actions for the evacuation of the fluids, after the manner of an active purgative,—these very effusions, also, instituting other circles of sympathy, which join in the great work of curative movements. Should vomiting now follow, then shall you speedily see the vital energies returning,—the cold pale skin giving place to a florid hue and a warm perspiration,—the sunken features starting into the fullness of health,—the gastric suffering gone as a luxury obtained,—the general whirl of anxiety and distress converted into calm tranquillity,—the headache dissipated,—the twang of the croup, or the grunt of pneumonia, no longer sounding an alarm;—and, all this stupendous succession of events, from the beginning of nausea to the restoration of the vital energies and the near

resolution of disease,—composing a most astonishing consecutive series of reflex actions,—may require less time than I have hastily employed in this general allusion to the subject. And now can it be entertained, that this has been the result of absorption, or that the laws of chemistry or physics have had any connection with the phenomena?

"The foregoing may be taken as an example of the principle which concerns the *modus operandi* of all curative or morbific agents, whether physical or moral, and of all the developments of disease that arise as sympathetic consequences of each other. In respect to emetics, however, it should be considered that all do not produce the foregoing effects, and that with the exception of the act of vomiting, the results will depend upon the precise nature of the emetic, or the manner in which it modifies the nervous power and thus impresses the organic properties. This explains the difference in results between tartarized antimony, ipecacuanha, sulphate of zinc, warm water, tickling the fauces, the mechanical irritation of undigested food, the shock of a fall, of a surgical operation, sailing, whirling, offensive sights, offensive odors, loss of blood, and even their recollection, &c.

"When the alterations, of a sympathetic nature, are more slowly produced, as when mercury induces salivation gradually, and brings the whole system under its influence, or when small, and repeated doses of tartarized antimony overcome inflammations of the lungs, &c., the nervous power is developed and modified at each successive dose, and the repetition of its influence upon the organic properties of diseased parts remote from the stomach establishes progressive changes, till an absolute condition of disease may be induced in certain parts, as when mercury salivates; while the analogous influences which are exerted on parts already diseased supplant the naturally morbid states by others of an artificial nature, from which the organic properties are able to return to their healthy condition. But these impressions must be frequently repeated; for if the interval be long between the administration of the doses of such agents as only produce their effects in a gradual manner, the diseased conditions, not being placed in the way of the recuperative tendency, will throw off the artificial impression, and the original intensity of disease will be thus restored, &c. The permanent operation of the nervous power in particular parts of the animal fabric, as in the sphincters, supplies an elegant parallel with the foregoing uninterrupted influences of the same power as developed by remedial or morbific agents, &c.

"When moral causes operate in the cure, or production of disease, they act directly upon the cerebro-spinal axis, and develop and modify the nervous power according to the nature of each mental affection; and, as in the case of physical agents, the nervous power thus developed and modified may be determined as well upon the organic properties of the brain and spinal cord, as upon other parts. The blow upon the region of the stomach, or the opening of a thecal abscess, which have destroyed life on the instant, operate in the same way as the paroxysms of anger, or of joy, which have been as suddenly fatal. In these cases the nervous power is first determined with a fatal effect upon the organic properties of the nervous centre."

Again, in the Essay, at p. 51 is the following correspondence with the Institutes at p. 672, § 904 *a*, which is introduced here on account of the Author's theory of the diverse modifications of the nervous power, and the same doctrine as quoted in the last paragraph at p. 914 of Institutes. The Essay thus—

"The nervous power is not only variously excited, *exalted*, or *depressed*, or *modified in its kind*, and produces influences upon remote parts according to these changes, but it is *reflected* upon particular parts according to their existing susceptibilities, the nature of the remote cause, and the part upon which the remote cause may operate. Thus one impression from cold, as a blast of cold air, or a drop of cold water upon the skin, will rouse the respiratory muscles. Another impression from the same cause will excite catarrh, or pneumonia, or articular rheumatism. (*See Med. and Phys. Comm.* vol. 2, p. 18, 41—50.) Mercurial ointment will determine the nervous power specially upon the salivary glands, and liver, and the same effects arise from the action of mercury upon the stomach. Cantharides, internally or externally applied, irritates the neck of the bladder. One degree of impression by tartarized antimony upon the stomach determines the nervous power upon the respiratory muscles, and vomiting is the consequence; while it simultaneously REFLECTS *the same power upon the skin*, as it does in smaller doses, and OF WHICH PERSPIRATION IS A CONSEQUENCE,—and so on. But these examples embrace," &c.—The emphasis of Italics and Capitals does not occur in the Essay.

NOTE Y.—THE NERVOUS POWER AND ELECTRICITY.

NOTE Y.—Whatever the Author may have said in objection to the supposed identity of the Nervous Power and Galvanism, and especially in his remarks as to the electrical circuit (p. 644, § 893 *a*, &c.), he desires to be understood as fully recognizing the fact that electrical currents may be developed artificially in nerves, even when detached from the body. This was demonstrated by Du Bois-Reymond, whose method of observation is well and briefly stated in the following extract—

"Every fresh excitable nerve is the source of electric currents, as may be proved by placing the two ends of the wire of a galvanometer in contact with it. But the position of the nerve is of great importance. If the nerve be placed so that the wires touch two points of its surface at an equal distance from the central point (equator) of the nerve, no deviation of the needle takes place; but when the wires are placed so that one touches the transverse section of the nerve, and the other a point on its longitudinal surface, a strong variation of the needle ensues, the current going from the external longitudinal surface to the transverse. The external surface is therefore positive (+) towards the transverse, which is negative (−) in its electric relations. If both wires be placed on the surface of a nerve, one nearer the centre point (equator) than the other, a weak current is produced, going from the point nearest the equator towards the point at a distance from it. A point near the centre point of a nerve is therefore positive towards a point at a greater distance from it. In muscle the same relations are found to hold in two points of a transverse section."

"The theory of Du Bois to explain these effects may be thus stated:—Every minute particle of nerve acts according to the same law as the whole nerve. A nerve consists of a number of di-polar molecules, one half presenting positive, the other half negative electric properties. These di-polar molecules are arranged in couplets, and so that the positive poles are turned towards each other, their negative poles to the extremities of the nerve. Each couplet of molecules produces currents going from the central positive poles to the negative poles. A nerve is always in the condition of a closed current, and when the extremities of the wires of the galvanometer are applied, a part merely of the current is abduced.

"The foregoing facts and theory apply to a nerve when it is in a state of rest. When a constant galvanic current is made to pass through part of a nerve, an electrical change takes place, to which the name electrotonus is applied. Supposing that while a piece of nerve is placed on the cushions of a galvanometer, and a constant deflection of the needle is produced, a constant current be passed through this piece of nerve in the same direction as the nerve current, then an increase of the deflection of the needle is observed. This is termed the positive phase of electrotonus. If a constant current be applied in a direction opposite to that of the nervous current, the deflection of the needle is decreased, and this is termed the negative phase of electrotonus. If a nerve be placed with its equatorial point exactly between the cushions, so that no deflection is produced, and if a constant current be now applied to the nerve, a deflection of the needle will take place, its direction being determined by that of the applied current. Such are the principal facts of electrotonus, and the explanation of them furnished by Du Bois is the following. When any portion of the length of a nerve is traversed by an electric current, besides the effect of the original nerve current, a new electro-motive action takes place, which has the same direction as the applied current. This new current is *added* to the original nerve current if the direction be the same, but *subtracted* from it, if the direction be opposite."—BRITISH AND FOREIGN MEDICO-CHIRURGICAL REVIEW, &c., Lon., *July*, 1862, p. 6, 7.

Admitting all the foregoing facts, and others of a corresponding nature, to be well ascertained, they can in no respect affect the validity of that other and vast series of facts presented in these Institutes which contradistinguish the nervous power from electricity, nor can imagination conceive of the functions of the latter when the phenomena of animals, physical and mental, and of plants, are considered according to their realities.—NOTE EEE.

NOTE Z.—URÆMIC POISONING. An experiment by Bernard (§ 1032 *d*) disproves *uræmia*, and shows that diseases of the brain, and merely sympathetic influences upon it, and mental emotions, may so affect the kidneys that they shall not only fluctuate greatly in their excretion of urine, but may generate irritants that stimulate the bladder to frequent micturition. It is not improbable that *diabetes* is greatly owing to influences of the nervous system upon the kidneys, which would show us that the sugar does not exist in the blood (§ 1032 *a*).

NOTES TO THE EIGHTH EDITION.

The following NOTES are added to the EIGHTH EDITION of this Work, and references to them are introduced in appropriate places in the text.

NOTE AA.—PHYSIOLOGY OF THE CEREBRO-SPINAL AND SYMPATHETIC NERVES.

There appears to be nothing in the researches into the functions and laws of the nervous system since the last edition of this work that can in any respect modify the statements and the philosophy as herein presented, but, on the contrary, go to their confirmation. Among the most intricate experiments, and corroborative of distinct orders of nerves as set forth in sections 197–201, 224, 446–447, 500 *g*, *nn*, 893 *a*, 893½, 1037 *b*, may be mentioned some late ones by C. Bernard upon dogs, in continuation of others performed several years ago, from which he deduces, as a general fact (and in conformity with results that had been already obtained by others), three distinct varieties of nervous influences, according to the origin, composition, and distribution of the nerves. Thus, in some late experiments upon the extremities of dogs he found, besides the motor influence for the voluntary muscles which is imparted by the anterior roots of spinal nerves, and the sentient influence which belongs to the posterior roots (§ 1037 *b*), that the vascular and calorific influence appertains entirely to the sympathetic nerve. These distinctions are fundamental throughout the Institutes. That which relates to the sympathetic nerve is mostly important, as through that I have interpreted all the influences upon organic functions and their results, whether in a physiological, pathological, or therapeutical sense, so far as nerves are tributary, and which, also, I have employed extensively in exposing the fallacies of the chemical and humoral doctrines.

Besides the foregoing distinctions there should be added the motor nervous influence for the muscles of organic life, which is imparted by the sympathetic nerve, and which is quite distinct from that which relates to the proper organic functions, since, as it respects its agency in exciting the action of the organic muscles it is on common ground with the motor influence of cerebro-spinal nerves, and goes no farther, while the same nerve exerts a special modifying influence upon the vascular system, upon all organic functions, and modifies the organic products (§ 111–113, 224, 356 *a*, 394–396, 446, 455 *a*, 459 *f*, 461, 461½, 473 *c*, 475½, 478 *b*, 483 *c*, 488½, 500 *g*, *m*, *nn*, *o*, 516 *d* Nos. 7–9, 524 *d* No. 7, 647½, 889 *g*, 893 *a*, *c*, 893½, 1044).

NOTE BB.—CAUSES OF THE HEART'S ACTION.

In respect to the doctrines of the dependence of *contiguous* sympathy upon ganglia and other local centres of the sympathetic nerve, and of the operation of vesicants, setons, etc., through those local centres, and of the independence of *continuous* sympathy or *continuous influence* of the nervous systems advanced in sections 129 *f*, 264, 475½, 498 *e*, 514 *f*, 515, 516 *d* No. 7, 893 *a*, *c*, 905 *a*, etc., it may be of interest to state the following conclusions obtained by GOLZ as to the instrumentality of the ganglia in the heart's action: 1. "The pulsating parts of a frog's heart constitute together a system of small independent apparatuses, each of which is possessed of a ganglionic central organ (§ 516 *d* No. 7). 2. These small nervous centres can be excited to action by various stimulants, and this action, according to its intensity, manifests itself in more or less protracted contractions of the muscles which are governed by the stimulated centre. The natural stimulus which incites the ganglia is the blood (§ 475½). 3. A sudden contraction of any part of the heart acts slightly stimulating upon the neighboring parts. Thus, when a stimulated part contracts, the contraction spreads like a peristaltic movement, according to the laws which depend on the connection of the nerves with the ganglia. 4. The reason why the heart contracts rhythmically is, perhaps, to be found in the following circumstance: As soon as the stimulating influence of the blood is powerful enough to act upon the ganglia, the systole at once commences, and emptying the heart, removes from it the stimulating cause" (§ 264, 383–386, 392–395, 475½, 514 *f*, 516, 1090).

NOTE Cc.—WHOOPING COUGH—THE PHILOSOPHY OF ITS TREATMENT.

I have expounded the physiological influences through which the act of vomiting will suddenly arrest a paroxysm of coughing, as witnessed in whooping-cough, for the purpose, particularly, of demonstrating by a distinct example the operation of emetics in organic life, through their action upon the organs of animal life, by the instrumentality of the nervous system, and thence showing how these simple examples may be employed in interpreting the analogous results of remedial and morbific agents in their removal or production of disease (INDEX II., *Whooping-cough*, *Hiccough*, and *Hysteria*). It will be seen that the example is parallel in its intended illustrations with many others which occur in this work, as in sections 500, 514, 516, 902 *g–m*.

As it respects the interruption of the cough by vomiting, the emetic influence is exerted upon the organic nerves of the gastric mucous tissue, while the point of departure for the excitement of the nervous influence that determines the cough is in the same nerves in the pulmonary mucous tissue, and in both cases the motor nerves belong to the cerebro-spinal system, and are implanted in the thoracic and abdominal muscles, and diaphragm (§ 514 *b*). Now, as I have said, whatever will excite vomiting during a paroxysm of coughing, even when produced by the cough itself, will at once interrupt the latter by so modifying the development and reflection of the nervous influence as to introduce a new combination of movements in the respiratory muscles (§ 514 *c*). If the vomiting be occasioned by the cough, or by tickling the throat, or by a mental emotion (NOTE D, p. 1114), or by warm water, or by an infusion of mustard-seed, the effect will go no farther (§ 902 *h*). To obtain, therefore, any influences from emetics upon the morbid conditions in whooping-cough, they must possess also other virtues than such as determine the act of vomiting, and it is through the special impression which those virtues make upon the gastric mucous tissue that such emetics simultaneously reflect an alterative nervous influence upon the absolute pathological conditions (§ 233½, 500 *g–l*, 514 *f*, *k*, 902 *d–m*, 1059). The best emetics for this combined purpose, and indeed the only ones for the alterative influence, are tartarized antimony and ipecacuanha. But in cases to which these are appropriate, their gradually alterative impression, as effected by small and repeated doses just short of nausea, is generally more salutary than emetic doses at distant intervals, since no greater extent of the remedy is commonly necessary in whooping-cough to bring about vomiting, as it is the tendency of the cough to reflect an emetic nervous influence upon the gastric mucous membrane, which will be likely to determine the act of vomiting when the same membrane is slightly predisposed by the irritating virtue of an emetic (§ 514 *b*, 516 *d* No. 6, 657 *a*, 889 *a*, *f*, *g*, 902 *e–i*, 904 *bb*, NOTE D, p. 1114). The same philosophy is applicable when an emetic interrupts a paroxysm of spasmodic asthma or of hysteria (§ 514 *c*, 891½ *c*, *f*, *k*).

NOTE Dd.—LEECHING, PHILOSOPHY OF ITS EFFECTS, HOW FAR DEPENDENT UPON VASCULAR COMMUNICATIONS.

Dr. William Turner appears to have demonstrated the very interesting fact of the existence of a system of anastomosing arteries between the visceral and parietal branches of the abdominal aorta, and which is likely to be followed by some highly practical advantages. This will be apparent from a remark which Dr. Turner makes in connection with his ingenious demonstration. "This assumption," he says, "of the absence of any direct communication between these two sets of vessels has been employed by some physicians as a *principal argument* against the utility of local bloodletting in the treatment of inflammation of the abdominal viscera. *Vide* Dr. BENNETT'S Clinical Lectures, 1859, p. 280."—This common objection is founded upon the universal mechanical philosophy of the modus operandi of loss of blood when artificially effected—a philosophy which excludes all the magnificent laws in physiology both as it respects the nervous influence and the organic endowments, and their involutions as instituted by the incidental operation of physical and mental causes, and is regardless of the inexhaustible testimony of the most enlightened experience (§ 910). But, although it is probable that the foregoing objection to leeching will yield to the anatomical fact demonstrated by Dr. Turner, the fact itself does not supply a ray of light to the mechanical Physicians, since the intercommunication

of the inosculating vessels is wholly insufficient for the hypothesis which supposes a diversion of blood from the internal organs to the very limited space over which leeches are applied, nor does the inosculation any more explain the operation of counter-irritants upon deep-seated inflammations; and the solution, therefore, which I have made of the resulting phenomena, whether of leeching or of counter-irritation, through the medium of the nervous system, will remain the only intelligible theory (§ 893 *a*, *c*, 905 *a*, 915–924, 942 *b*). As it respects the law of continuous sympathy, its operation, in leeching, when involving only the bloodvessels, is limited to the vessels of the skin, and is more or less circumscribed, according to the number of leeches, and the special circumstances of every case. When the bloodvessels alone are interested, the propagation of this continuous influence along their course is of very little moment excepting as it is tributary to reflected actions of the nervous centres (§ 498, 917, 919).

NOTE EE.—THE REMEDIAL VIRTUES OF ANTIPHLOGISTICS AND TONICS CONSIDERED RELATIVELY.

The almost endless variety of virtues which appertain to the remedies that are adapted to the treatment of inflammations and fevers, or which may be created by uniting two or more of them together, and also according to the proportions of each constituent (§ 860, 863 *d*, 872 *a*, 889 *k*, 892 *b*, 892¼ *a*, 1058, 1060–1065), contrasted with the single property that alone characterizes, as a remedial virtue, any member of the groups of tonics and stimulants, should assure us that the former are designed for the multifarious conditions of inflammatory and febrile diseases, while the latter is equally pronounced, by its solitary virtue, to be suited only to such forms or conditions of disease as are nearly allied to each other (§ 890½ *a*, *h*), and where, by common consent, the remedies that are deficient in that special virtue have comparatively little or no tendency to introduce the restorative process, but, on the contrary, generally aggravate the conditions which the stimulants relieve. The phenomena which ensue upon the operation of tonics and stimulants, whether of a salutary or morbific nature, are the same, respectively, throughout; and, although loss of blood, cathartics, emetics, the mercurial and antimonial alteratives, blisters, and other things belonging to the class of antiphlogistics, will alike make their salutary invasions upon all forms of inflammation and fever, yet in all the cases there is not only a want of coincidence in all the direct manifestations, but the greatest diversity—scarcely any thing in common beyond the subsidence of disease (§ 900, 1059, 864).

Since, therefore, it is abundantly evident that the great varieties of remedies denominated antiphlogistics, ranging from loss of blood, cathartics, emetics, mercurials, antimonials, vesicants, and other agents that are adapted to the common form of inflammation and fever, to iodine, cinchona, arsenic, cobweb, colchicum, veratria, etc., which are suited only to the specific forms, are endowed with an incalculable variety of remedial virtues, and, also, that their combinations, both as to the number and nature of the constituents and the proportions of each, extend the variety of their virtues indefinitely (§ 872), while, on the other hand, tonics and stimulants possess but a single virtue in their relation to disease, and are incapable of yielding any new ones by their combinations, or of displaying any of the variety of effects common to the antiphlogistics by simply varying the doses (§ 516 *d* No. 6, 1057½), it needs no farther demonstration to show that the former are intended in Nature for a vast variety of pathological conditions, while the latter are as distinctly limited to the simple office of reviving the exhausted or the prostrate powers of life.

The foregoing comments have grown out of the numerous contrasts that have been instituted in this work between antiphlogistics and stimulants; and I am finally led to consider a principal reason for the remarkable ascendency which the stimulating practice has obtained at this advanced age of knowledge. The recital will be at least interesting to the future historian, and can not fail of a useful effect upon the "Divine Art." The foundation of the evil is variously presented in these Institutes, which may be briefly said to consist of the physiology which has been proclaimed from the laboratory of the Chemist, and the pathology which has sprung from the same factitious pursuits, and a reliance upon morbid anatomy and the microscope, to the exclusion, in all this vast and diversified field, of the signs and philosophy which distinguish organic nature in its living condition. The absence of principles, therefore, leaves the Profession as much without a guide in practical medicine as the mariner at sea without his compass.

This brings me to an important practical comment upon the revival of an old doctrine which has been lately inculcated by many distinguished medical writers, and extensively accepted by the Profession—formerly called "a meditation upon death." Say they: "Diseases can not be arrested at any stage of their progress, even at their earliest, unless it be some special form, like the intermittent fever, where an antidote has been discovered for the *blood poison.*" Hence the dogma has arisen that tonics and stimulants are all that can be usefully employed, with the object of "sustaining Nature while she is engaged in eliminating poisons from the blood," or in some analogous office, and therefore, also, that bloodletting, cathartics, and other depressing means must be injurious. This logic is at the foundation of a vast amount of practice.

The important question now arises as to the real origin of the dogma that most, if not all, diseases run an indefinite course of rise and decline in spite of all remedies and the best directed skill. The answer is to be found in the pernicious effects of the tonic and stimulating treatment, since, as I have variously shown upon the soundest principles, and by the authority of all the best experience from the day of Hippocrates to our own, that method of treatment prolongs all acute maladies till the morbid process may succumb to the physiological laws of recuperation (§ 756 *a*, 853, 856 *a*, 863 *h*), when tonics and stimulants may yield an advantage that has led, under these delusive circumstances, to their employment at the early stage of disease. The curious fact, therefore, presents itself, that the stimulating practice began at an early period of disease quickly confirms the morbid process, and thus contributes, along with the neglect of appropriate remedies, to the conclusion that all diseases terminating favorably run on until they run out; while the same treatment, continued after recuperative nature may have struggled successfully against it, is supposed to have been tributary throughout to the fortunate issue.

This all-pervading school (permitted, perhaps, as an auxiliary means in the dispensations of Providence) is naturally sustained by the prejudices and propensities of the community, which render it less susceptible of reformation. But it suffers in its dimensions by many seceders, whose experience with the stimulating treatment had equally enforced the conclusion that diseases can not be stayed in their progress toward a natural termination, and that tonics and stimulants fall under the category of all other remedies, and who, therefore, insist that Nature should be left to the simply watching system (§ 878), or at most to the aid of tonics and stimulants when her resources become apparently exhausted. Occasionally, also, disciples of the stimulating school are prompted by their unfortunate experience to try the method at which they had so long revolted, and if they venture as far as copious bloodletting, and purging, in grave inflammations and congestive fevers, they are astonished to find that all these diseases may be suddenly arrested at their early stages, and that life should be thus as uniformly saved as it had been as uniformly lost by the stimulating treatment—nor are there wanting illustrious examples to whom these remarks apply (§ 1005 *a–h*, NOTE FF).

I do not flatter myself that what I have now and hitherto said on the foregoing subject will exceed the usual small allotment in advancing the interests of truth in its conflicts with error. They are arrayed in uncompromising hostility, and however powerful may be the weapons of the one, they are wielded by a few against a multitude who are intrenched in the fortress of "Common Sense," and rejoice in the delusion of *vox populi vox Dei.* Simplicity and plausibility are the triumphant advantages of error. A single fact that addresses itself strongly to the senses often outweighs a multitude of contradictory ones which can be developed or appreciated only by patient research and profound meditation. This contrast between truth and error may be well exemplified by the apparent and real motions of the heavenly orbs. "Common Sense" assumes that the earth is stationary and that the heavens revolve about it; but reason, through its profound investigations, decides that "Common Sense" is in error. But ages elapsed, and an incalculable amount of intellectual labor was brought to the subject before the error could be dispelled. Indeed, it is said that, even at this age, the "Doctors of Salamanca" daily crucify Galileo, greatly preferring the promptings of Sense to the difficult revelations of science (§ 1 *b*, 5¼ *c*).

And just so it is with whatever is true or false in medicine. With the multitude "Common Sense" is forever the victim of appearances. It believes, for example, that "debility" is the essence of disease, having no conception that it is a mere symptom, and no reference to the latent causes upon which it depends and which alone should guide the practitioner. "Common Sense" is also greatly responsible

for the delusions with which Humoralism and Organic Chemistry have vitiated medical science. Nothing, for example, can be plainer than that the matter of eruptive diseases comes from the blood, and, therefore, Common Sense, according to its usual superficial manner, argues that the blood is the essential seat of the malady, and that tonics and stimulants are alone wanted "to sustain the strength while the blood is casting off its impurities." Upon the same ground, "blood poison" is the descriptive phrase for the whole pathology of typhus, intermittent, yellow, and other fevers, for which the same sustaining treatment and its philosophy obtain; or here quinine is supposed to neutralize the reputed poison, or, at other times, and in other maladies, iron is a favorite to "enrich the blood," or iodine as a peculiar purifier (NOTES K, N, R). And this, according to the "recent progress of medical science," about exhausts the Materia Medica. As an example of "the progress," calomel and tartarized antimony are excluded by the Surgeon General, Dr. Hammond, from the armies of the United States of America. Calomel is forbidden, he proclaims, "with the more confidence, as MODERN PATHOLOGY [!] *has proved the impropriety of the use of mercury in very many of those diseases in which it was formerly unfailingly administered.*" And this is only a little more arbitrary (because sustained by military power) than the general policy by which Humoralism and Organic Chemistry have nearly crushed out all that is most valuable in medical science (§ 5½ *a*, 819 *b*). If Solidism raise its voice in solemn protest, "Common Sense" points to debility, or to pustular eruptions, or to vitiated secretions, and curls its lip at whatever is grand, and magnificent, and practical in the laws of the organic functions and of the nervous systems. But nothing is more certain in the future than that, "ere the account be closed, principles will stand for something, and conscience, as in all human affairs, will have the last word."

NOTE FF.—BLOODLETTING IN YELLOW FEVER, AND IN OTHER CONGESTIVE FEVERS, CONTRASTED WITH THE STIMULATING TREATMENT.—NO CHANGE IN THE TYPE OF DISEASES.

Besides the great amount of enlightened experience which this work supplies upon the importance of Bloodletting in Yellow Fever (§ 959 *b*, 992 *a*, *b*, 993, 999, 1002, 1004, 1005½), and more particularly the *Medical and Physiological Commentaries*, the unexampled fatality of that disease in recent times (so manifestly arising from the stimulating treatment, § 1068 *b*), leads me to some specific statements as to the quantity of blood which was often found necessary to the best success in the epidemics which visited Philadelphia toward the close of the last century, while it will be also seen that the principal physicians of that city applied the remedy to an extent demanded by the exigencies of the disease. Nevertheless, the tonic and stimulating treatment prevailed at first, universally, and had then, as now, no reference to the essential condition of the disease, but was, equally as at this day, addressed to that superficial symptom *debility*, which, in its popular acceptation, is attendant upon all diseases (see INDEX II., DEBILITY). It is, indeed, for the reason that the *symptom* is supposed to constitute the disease that tonics and stimulants are now the only remedies, in a general sense, that are in the hands of the profession, and the antiphlogistic condemned as unwarranted by this leading principle in pathology. But it is a more inexplicable paradox that the mortality attending the stimulating treatment does not oftener appeal to the judgment or the conscience of these triflers with human life. The annals of medicine supply but few examples of an abandonment of a practice which has constantly illustrated its own errors and the dogma upon which it has been founded. These few are mostly limited to able thinkers, who are quoted in this work (§ 1005 *a–h*). Rush has supplied, in his *Medical Inquiries and Observations*, a few instances that were signalized by the yellow fever of 1793. "Dr. Pennington," he says, "informed me that he had lost all the patients to whom he had given bark and wine. Dr. Johnson assured me, with great concern, about two weeks before he died, that he had not recovered a single patient by them. Whole families were swept off where these medicines were used. There was not a single cure performed by them in New York, where they were used in several sporadic cases with every possible advantage. But why do I multiply proofs of their deadly effects? The clamors of hundreds whose relatives had perished by them, and the fears of others, *compelled* those physicians who had been most attached to them to lay them aside, or *to prepare the way for them*, as it was called, by purging and bleeding." The physicians who adopted the latter practice "gave calomel by itself, in

small doses, on the first or second day of the fever, bled once or twice in a sparing manner, and gave the bark, wine, and laudanum, in large quantities, upon the first appearance of a remission. This practice was not much more successful than the purely stimulating. It resembled throwing water and oil at the same time upon a fire in order to extinguish it." Nothing, indeed, succeeded but decisive bloodletting and purging with the right cathartics. This was farther illustrated by the French practice, of which the following is an example. The hospital at Bush Hill, "where most of the patients were sent in the first stage of the fever, and provided with all the necessaries and comforts that humanity could invent, or liberality supply, was placed, after September 22d, under the care of a French physician, who employed *moderate* bleeding, and purging with salts in some cases," and also "nitre, cream of tartar, camphor, centaury tea, and tamarind water," but no bark and wine. The result was that the deaths between September 22d and November 6th amounted to 448 out of 807 patients who were admitted into the hospital within that time. "Three fourths of all the blacks (nearly twenty) who were patients in this hospital died;" while Dr. Rush remarks, in another place, that "a great number of the blacks were my patients, and of these not one died," under his treatment of bloodletting, and purging by calomel and jalap (863 *d*).

Of the practice of "moderate bleeding" Dr. Rush remarks that "an increased action of the bloodvessels was the consequence (§ 965 *b*, 985 *b*), and thus complaints of the chest and head were made worse by a single bleeding. This excited or strengthened the prejudices of patients and physicians against it" (§ 1000–1001). These patients died, and are among the multitude of instances which sustain the enlightened experience already quoted (§ 994–1001, 1005). Sydenham makes the same affirmation of the plague. "It is not at all surprising," he says, "that bleeding in a small quantity should be always prejudicial; but I appeal to the physicians who continued in town during the late plague (London, 1665 and 1666), whether *free and repeated bleeding*, before a swelling (bubo) appeared, was ever observed to prove fatal to any of the infected." He speaks of the opposition to bloodletting as "a vulgar prejudice" (§ 1000).

It is remarkable that Dr. Rush should have begun the treatment of the yellow fever of 1793 by tonics and stimulants—"bark, wine, brandy, and aromatics." But after a disastrous experience, he confesses, with much lamentation, to a total failure; and his conversion to bloodletting, and purging with calomel and jalap, and the triumph particularly of the former remedy, are so coincident with the experience of Hey, Gordon, Denman, and Cleghorn, as related in section 1005, that they may well be incorporated in that category of frank confessions of disastrous experiment leading to the recognition of philosophical principles and triumphant success. "Heaven alone," says Dr. Rush, "bore witness to the anguish of my soul in this awful situation. But I did not abandon a hope that the disease might yet be cured." Among the causes of his substitution of bloodletting for stimulants "were frequent hemorrhages from every part of the body;" and while they afforded "perfect relief" at advanced stages of the disease, "not a single death occurred from natural hemorrhages in the first stage of disease" (§ 805, 863 *a–h*, 1018). He felt his way, however, cautiously, thus manifesting that predilection for the fatal practice which we have seen to be true of other converts till aroused by the havoc it produced (§ 1005 *a–h*). "I began," he says, "by drawing a small quantity of blood at a time." This "satisfied him of its safety and efficacy," and he grew bolder. "Never before," he says, "did I experience such sublime joy as I now felt in contemplating the success of my remedies." As an evidence of this he makes an extract from his note-book, dated September 10th: "Thank God! out of one hundred patients, whom I have visited or prescribed for this day, I have lost none" (§ 1004 *c*). The sunken pulse and prostrated strength rose under repeated abstractions of blood (§ 961, 967, 1004 *b*). "I paid no regard," he says, "to the dissolved state of the blood when it appeared on the first or second day of the disease, but repeated the bleedings afterward in every case where the pulse continued to indicate. It *was common to see sizy blood succeed* that which was dissolved." "The presence of petechiæ did not deter me from repeated bloodletting where the pulse retained its fullness or tension" (§ 1002 *d–f*). "I bled many patients twice, and a few three times a day" (§ 999 *a*, *b*). "I did not lose a single patient whom I bled seven times or more in this fever." "I cured" (after he had abandoned tonics and stimulants) "a greater proportion than ninety-nine out of a hundred of all who applied to me on the first day of the disease, before the 15th day of September" (§ 557, 861). "After the 15th my success was much limited compared with what it had been before that time. But at no period of the

disease (with the qualification aforesaid) did I lose more than one in twenty of those whom I saw on the first day." "The number of deaths between the 1st of August and the 9th of November amounted to 4054." Notwithstanding, however, the stimulating practice obtained with many of the physicians throughout the greater part of the epidemic, Dr. Rush remarks that "not less than 6000 of the inhabitants of Philadelphia probably owe their lives to purging and bleeding during the autumn." "Many whole families, consisting of five, six, and, in three instances, of nine members, were recovered by plentiful bleeding and purging." Other physicians gradually adopted the depletive treatment, "one of whom cured ten in the family of Mr. R. Haydock by means of the remedies." "Dr. Pennington" (who had *lost all the patients* to whom he had given bark and wine) "assured me on his death-bed that he had not lost one out of forty-eight patients whom he had treated agreeably to the principles and practice I had recommended. Dr. Griffiths triumphed over the disease in every part of the city by the use of what were called the *new remedies*." Of his own success in the epidemic of 1797 he says, "I lost but one patient who had been the subject of early and copious bleeding. His death was evidently induced by a supper of beefsteaks and porter during convalescence."

To the untiring perseverance of Dr. Rush is due the overthrow of the stimulating treatment, which reckoned almost every patient as its victim, as shown by the success of the antiphlogistic practice. That fearless man, in the midst of great obloquy, "defended his treatment in the public papers against the attacks that were made upon it by several of the physicians of the city." "This controversy with my brethren," he adds, "with whom I had long lived in friendly intercourse, carried on amid the most distressing labors, was extremely painful to me." But he finally triumphed, and his memory presents an imposing contrast with that of his opponents. The disastrous effects of the bark and wine treatment "in some of the most opulent families in the city, and the *almost uniform success of the depleting remedies*, happily restored the public mind, after a while, from its distracted state, and *procured a submission to the latter from nearly all the persons* who were affected with the fever." Of the epidemic of 1794 he remarks that, "in Philadelphia and Baltimore, where bleeding and purging were used in due time, and as I have described, not more than one in fifty died of yellow fever." "In 1797 *the stimulating mode was deserted by every physician in the city.*"

In regard to the quantities of blood which were often abstracted, the following are examples in the epidemic of 1794. Dr. Rush supplies a table of 23 cases in his own practice, in which the quantities varied from 50 to 150 ounces, "taken in three, four, and five days." "I did not cure a single person," he says, "without at least one bleeding." In the epidemic of 1793 he has examples to the extent of 100 ounces at repeated bleedings. In the epidemic of 1797 he mentions five individuals whom he bled to the extent of more than 100 ounces. In the same epidemic "Dr. Dewees bled Dr. Physic 176 ounces; Dr. Griffiths bled Mrs. Thompson 110 ounces; Dr. Stewart bled Mrs. M'Phail 106 ounces; Dr. Cooper bled Mrs. Evans 150 ounces; and Dr. Gillespie bled himself 103 ounces. All these persons had a rapid recovery" (§ 992, 994). In the epidemic of 1798, "Dr. Mease was bled 162 ounces, and Mr. J. C. Warren 200 ounces," and recovered. When bleeding had been neglected in very prostrated cases, "Nature often performed that operation upon herself from the gums on the fourth or fifth day. I have seen several pounds of blood discharged on those days with the happiest effects. It appeared to take place after the revival of the bloodvessels from their prostrated state" (§ 805, 863 *f*, 890 *d–g*, 961–964, 984 *c*, 1018–1019, Notes Gg, Ii). In the epidemic of 1799 "there were few cases that did not indicate bleeding. Mr. Rowan lost 200 ounces of blood by 22 bleedings" (§ 999 *a*, *b*).

If we now compare the mortality from yellow fever that has distinguished the tonic and stimulating treatment for the last forty years with the results of the stimulating and antiphlogistic methods of the last century, it will be seen that the profession is again called upon to return to principles, and to that enlightened experience from which the principles have been deduced (§ 1004 *a*), and to surrender the prejudice that the same diseases so fluctuate in their type in different countries and at different seasons as to require opposite modes of treatment (§ 752–756, 960 *g*, 969 *d*, 1006 *a–g*, 1068).

NOTE Gg.—BLOODLETTING IN DYSENTERY.

This note is in connection with § 863 *f*, 890 *e*, 984 *c*, 991 *b*, 1019, 1058 *f*, and Notes F, Ff. In Note F I had occasion to quote the high authority of the *British and Foreign Medico-Chirurgical Review* in proof of the disastrous effects that have resulted from the abandonment of bloodletting in the early stages of diseases of the lungs, and it is now my purpose to quote the same authority to show as remarkable a contrast between the results of the treatment of dysentery by bloodletting, calomel, opium, etc., as practiced during the British naval expedition to China in 1840–'42, and which "was most in vogue twenty years ago," and the treatment adopted during the second expedition for the three years 1857, '58, '59. Thus the Review:

"Of late years (and during the second expedition) the heroic or active treatment by depletion, etc., has fallen into desuetude, and reliance has been placed on milder measures. Ipecacuanha, in the manner recommended by the Indian practitioners, has been largely tried, together with hydrarg. cum creta, opium, the mineral acids, topical bleeding, counter-irritants—in short, all the older remedial agents, *excepting general bloodletting and calomel*."

Now, says this able digest of the "Medical Results of the recent Chinese Wars," "By presenting the products respectively in the form of figures, the mind will seize at a glance the *painful disparity*.

Years.	Number of Men employed.	Cases of Dysentery.	Number invalided.	Number died.
1840–1–2.....	15,470	2102	60	188
1857–8–9.....	24,980	2006	606	465

Thus, in rough numbers, in the first Chinese war, one out of every eight and a half of the men attacked succumbed or was disabled from service; in the second Chinese war, one out of every two."

It appears, therefore, according to the foregoing account of the treatment, that the "painful disparity" is to be attributed to the neglect of general bloodletting, since the other "heroic remedy," "calomel pushed to ptyalism," has been only an occasional remedy for dysentery—never, indeed, much practiced either in Europe or America. But, more than all, I am most happy to hail a returning appreciation of the accumulated experience of the past (though it be the slow result of "a painful disparity"), as expressed in the following quotation from the article to which I am indebted, and which was contributed to the Review by T. Nelson, M.D., Staff Surgeon, R.N.

"Taking a dispassionate and impartial view of the facts as they have just been disclosed, the conclusion to which they lead can not be avoided, namely, that the recent method of treatment of dysentery in China, so far from having become more successful from the additional experience which twenty years confer, has, on the contrary, very decidedly retroceded. In presence of this painful but inevitable inference, it becomes a subject for serious consideration whether the *much contemned practice* of twenty years ago has not been superseded somewhat rashly, for another which, *conforming to the quietism of the day, has brought about* a series of results that in these times has no parallel" (§ 1005 *b–h*, Note Ff).—*British and For. Med. Chir. Rev.*, July, 1863.

In the last conclusion the writer is mistaken as it respects the relative excess of mortality from other modes of treating dysentery, for the stimulating and astringent method, now in vogue, supplies a "more painful disparity" than the simple exclusion of general bloodletting from the antiphlogistic treatment practiced by the British surgeons during the second Chinese expedition.

NOTE Hh.—MEMORY SUDDENLY LOST, AND SUDDENLY RESTORED BY FREE BLOODLETTING.

On the 26th of October, 1862, at eight o'clock A.M., I was requested to visit Dr. O. B., a medical gentleman of this city, who had sustained, in the course of the preceding night, a loss of memory. I had passed the evening in conversation with him, at which time his memory was perfect, and he had been attending to his usual avocations abroad during the day. His age was about 62 years, slender in his person, and he had suffered in former years much infirmity of health, which was still habitually delicate. The case presented some very remarkable intellectual phenomena;

and I record it not only for that reason, but in farther defense of the great remedy against which so insane a prejudice prevails. It goes, moreover, with the rest in showing that diseases do not fluctuate in the supposed manner in their pathological conditions (§ 1005½ *a*, 1068).

The case presented a total obliteration of memory as to the past and passing events, but it was sufficient for a connected association of ideas, and reason was apparently sound as it respected subjects immediately present to the mind. His remarks referred alone to the occurrences of the moment. As examples of the failure of memory, the doctor had no recollection of my visit on the preceding evening, and when this information was repeated several times in as many successive minutes, it was already lost to his memory. And so of other things, upon which he would reason correctly, but would totally forget the conversation and the subjects about as quickly as the words succeeded each other.

I was informed by his family that he had complained for ten days of some headache, but that in other respects he had made no unusual complaint of his health. His pulse was about ninety strokes in a minute, full, strong, and rather hard and incompressible (§ 688 *d*, *e*); tongue clear, appetite unimpaired, muscular strength undiminished, skin natural. He had arisen from bed at his usual hour. Of the headache he had no recollection; and the only circumstance which reconciled him to medical treatment was the full consciousness that he had lost his memory. And yet this consciousness existed only at the moment when his attention was brought to the subject. And so, also, in respect to the treatment. When bloodletting was proposed he raised objections to the remedy, but would forget within a minute that it had been the subject of discussion; and even, at last, when the preparation for bleeding was ready, he was astonished at being informed that it was my purpose to bleed him, and that he had not been consulted upon the subject.

The pathological condition, in my judgment, was venous congestion of the brain —such as is apt to result in apoplectic attacks. I therefore anticipated the best results from the remedy, and that the system would bear a free abstraction of blood under the stimulating nervous influence developed by the cerebral excitement (§ 975, 978, 979). The patient sat in a chair, and thirty-two ounces of blood were abstracted, when the radial pulse had yielded sensibly in force, fullness, and frequency, with other indications of approaching syncope, which, however, did not ensue. While the blood was running I gave particular attention to the state of the mind, and ascertained that the memory was progressively returning, and it was completely restored within an hour after the blood had been abstracted. The patient continued to move about the house during the day, and about the city in two days afterward. He had no more headache, and no medicine was administered. There has been now an interval of about two years, and there has been at no time any manifestation of "debility," but rather an improved vigor of health.* Nor has there been any disturbance of the memory, though it is an interesting fact that the doctor remembers nothing of the occurrences of the morning of the 26th of October prior to the abstraction of the blood (§ 1072 *b*, 1078 *o*).

NOTE II.—INTESTINAL HEMORRHAGES CURATIVE IN TYPHUS FEVER, ETC.—IDENTITY OF TYPHUS AND TYPHOID FEVERS.

Notwithstanding the accumulated experience, throughout all the ages of Medicine, of the salutary effects of spontaneous hemorrhages, particularly as incident to congestive fevers, the following statement, being comprehensive and one of the latest, may be usefully added to the other evidences upon that subject recorded in this work. At a meeting of the New York County Medical Society, held March 2, 1863, Dr. H. D. Bulkley, a physician of learning and ability, remarked that,

"With regard to the value of intestinal hemorrhages in typhoid fever, Drs. Bretonneau, Chomel, Louis, and others, considered this a dangerous symptom, but that Dr. Graves thought it rather favorable than otherwise, provided the loss of blood was not extreme. M. Trousseau was at first surprised at this opinion of Dr. Graves, but finds, on looking over his cases, that in seven years he has known but two deaths from such hemorrhage. Others attacked with it not only recovered, but *were better afterward*. Dr. Ragaine, in a memoir on this subject sent to the French Academy, relates one hundred and fifteen cases of typhoid fever, of which eleven suffered from hemorrhage, and they all recovered" (§ 805, 863 *e*, *f*, 890 *e*, 922, 984 *c*, 1002 *f*, 1006 *d*, *g*, 1017 *b*, 1018–1019, 1068, NOTES F, Ff, Gg).

* Eight years have now elapsed, and Dr. BRONSON has continued in an improved state of health—1870.

In respect to the identity of typhus and typhoid fevers, as shown in NOTE S, it may be farther stated that on the foregoing occasion, "Dr. Bulkley considered typhus and typhoid fevers as varieties of the same disease;" that "Dr. Finnell maintained his belief in the identity of typhoid and typhus fevers;" and that "Dr. J. Foster considered the two types as one and the same malady"—all the gentlemen deducing their conclusions from personal experience.

NOTE KK.—DIPHTHERIA.

A brief reference to this complicated disease is made in a *note* at page 350, and at page 450, § 689 *l*, for the purpose, especially, of indicating the pathology of the disease; and it is now my object to reproduce those considerations in connection with the very fatal effects of the almost universal treatment of the epidemic by tonics and stimulants, and to commend to the Profession what appears to me to be the only method which is warranted by the general and the local pathology, and which, in my hands, has been attended by speedy relief, even in infancy—that is to say, the strictly antiphlogistic. Decisive bloodletting, either by the lancet or by leeches, is generally indispensable; after which a moderate dose of calomel, or of blue pill, to be soon followed by castor oil, or the oil without the mercurial remedy (§ 1057 *l*), will be about all of an active nature that can be advantageously done.* The superficial hypothesis of debility is the source of the appalling mortality, and is of the same nature as that which is examined in sections 487 *h*, 569 *b–e*, 621 *a*, 743, 752–756, 785, 815, 887, 961–970 *c*, 992 *c*, 999 *c*, 1005 *b–h*, 1006 *f*–1007 *b*, 1068 *a*, *b*, NOTES F, FF.

NOTE LL.—THE PULSE AS A GUIDE TO BLOODLETTING.

It is a remark of Dr. Rush that "where all the different states of the pulse which indicate the loss of blood are perfectly understood, and bloodletting conformed in *time* and *quantity* to them, it never can do harm in any disease. It is only when it is prescribed empirically, without the direction of just principles, that it has ever proved hurtful."

The foregoing statement occurs in Rush's account of the yellow fever of 1794, and in his "Defense of Bloodletting" he mentions particularly, in the form of very brief abstract rules, ten different "states of the pulse that indicate the necessity of bleeding." It may be safely said, however, that the "necessity" can not be inferred from any one of the conditions without the light of other symptoms which refer more immediately to the seat and pathology of the disease; and many of the modifications will be thus found to contra-indicate oftener than they "indicate the necessity of bleeding." Nevertheless, the foregoing remark, however accidental it may have been, is probably true in a universal sense, for it is a summary principle founded upon all the circumstances of individual cases of disease.

Looking, therefore, at the fluctuations of the pulse according to the seat, nature, force, and duration of the disease, it becomes evident that this universal symptom, as a *guide* to bloodletting, involves a critical inquiry into all the circumstances of disease that can modify the action of the heart and bloodvessels, and from which it appears that it must be very generally these combined circumstances in connection with the state of the pulse, and oftener the former more than the latter, which must determine the propriety of bloodletting, and "the time and the quantity" (see *Index* II., PULSE). The pulse, at best, as I have endeavored to show, informs us only of the nature of reflected nervous influences that are propagated upon the heart and arteries by all diseases except the cardiac, as, also, by the action of remedial agents, by mental emotions, etc. (§ 500 *m*, and *references* there, 687½–688). The pulse, therefore, in the foregoing acceptation, may be regarded as the sum of all the symptoms, but that its true or exact import can never be known without a reference to those symptoms. Nevertheless, the multitude consider only the state of the pulse and "debility," without any regard to their causes; or, rather, the former has nowadays lost all its significance, and "debility," representing universal pathology, directs the hand of the practitioner (§ 887). This will be manifest on considering the stimulating treatment of those diseases which are attended by a hard and incompressible pulse (§ 688 *d–f*), such as pneumonia, enteritis, phrenitis, phthisis, etc.

* The pulse and muscular strength are in no respect guides. Both are apt to be prostrated by the attendant abdominal congestion (§ 689 *l*, 801, 961, p. 350, *note*).

NOTE Mm.—DEATH-RATE IN THE CITY OF NEW YORK, AND ITS CAUSES.

In preceding editions of this work (p. 872, 1115) I have presented the statistics of mortality in the City of New York from inflammation of the lungs, bronchitis, croup, and consumption, during the months of January, February, March, and April for the years 1860, '61, '62, for the purpose of showing the results of the substitution of the stimulating for the antiphlogistic treatment, and that the "excessive death-rate" in this city is not owing to climate (than which there is no city more exempt from disease), nor to any temporary insalubrity of the atmosphere; and with the same intention I shall now record the statistics for the same months in the years 1863, '64.

In 1863, the total number of deaths during the foregoing months was 7741, of which 636 are reported as Inflammation of the Lungs; Bronchitis, 185; Croup, 383; Consumption, 1205; or nearly 1 in 12 from Pneumonia, 1 in 20 from Croup, and 1 in 6 from Consumption. The ratio of deaths from the four diseases to the total number of deaths from all causes is about as 1 to $3\frac{1}{4}$.

In the year 1864, the total number of deaths during the same four months was 8493, of which 839 were from Inflammation of the Lungs; Bronchitis, 164; Croup, 352; Consumption, 1260; or nearly 1 in 10 from Pneumonia, 1 in 24 from Croup, and 1 in $6\frac{3}{4}$ from Consumption. The ratio of deaths from the four diseases to the total number of deaths from all causes is about as 1 to $3\frac{1}{4}$.*

It is thus seen that there has been nearly the same mortality from the four inflammatory diseases during the first four months of the five consecutive years. I shall make no farther comments upon this mortality, nor upon the practice which is greatly responsible for it; but it may be worth while to show the death-rate from consumption for entire years, which for the last five is as follows: In the year 1859, the total number of deaths from all causes was 21,645, of which the rate from Consumption was about as 1 to $6\frac{2}{3}$; in 1860, total deaths 22,710, rate from Consumption about as 1 to 7; in 1861, total deaths 22,117, rate from Consumption as 1 to $7\frac{1}{3}$; in 1862, total deaths 21,241, rate from Consumption about as 1 to $6\frac{2}{3}$; in 1863, total deaths 25,196, rate from Consumption about as 1 to $6\frac{1}{4}$.—See Note F, p. 1114.

The statistics have been obtained from the able and elaborate reports of Cyrus Ramsay, M.D., LL.B., Registrar of Records and Statistics in the City Inspector's Department.

NOTE Nn.—NARCOTICS AND SENSO-PARALYSANTS AS TO PAIN.

A characteristic and practical distinction between the groups of Narcotics and Senso-Paralysants, according to the nature of the agents which I have assigned to those groups respectively, in my work upon Therapeutics and Materia Medica (§ 891, 1057 *d*), and upon which, particularly, the groups are founded, is, that the Narcotics exert their most characteristic effects upon the organs of organic life, while the Senso-Paralysants are felt mainly in the organs of animal life. This is remarkably true of pain, for the relief of which in the great organs of life, so far as it respects the nervous agents, we are mostly limited to opium, hyoscyamus, and conium, which are nearly useless in neuralgia and other painful affections of the organs of animal life, while it is in these conditions, and not in painful affections in organic life, that aconite, veratria, belladonna, delphinia, and stramonium display their anodyne virtue. They exert no soporific effect in their ordinary doses, and when such doses are followed by sleep it is owing to the removal of pain.

NOTE Oo.—RELATIVE LIABILITY OF MASTER AND SLAVE TO PESTILENTIAL DISEASE.—MORE ABOUT ANIMAL HEAT.

When speaking of the subordinate predisposing causes of disease which increase the susceptibility of the system to be acted upon by the essential ones in cases of epidemics, and which, also, add to the intensity of disease, I attributed the comparative exemption of the Negro from the epidemic fevers of the Southern States to his abstinence from stimulating food and stimulating liquors (Index II., art. *Acclimation*, 3d subdivision; also § 630 *e*, 663, 814, 816 *b*, 827 *e*, 883 *b*); and it is now my purpose to simply state the habits of the Negro in that respect, as represented by a

* We learn from Bellevue Hospital (N. Y.), that in the treatment of *Pneumonia* "the olden methods of sanguineous depletion with antimonials have been swept away *by the advance of medical science*."—*Am. Med. Times*, 1864. Note Ee, as to the "*advance of modern pathology*," and § 5½.

distinguished observer who had resided several years in their midst, and whose husband was the wealthy proprietor of a large plantation. This information is derived from a "Journal of Residence on a Georgian Plantation," by Fanny E. Kemble (then Mrs. P. Butler), in which it is said that "the slaves labor hard all day upon *two meals* of Indian corn, or hominy, as it is called, as the regulation on this plantation, and our Negroes are *generally considered well off*. They go to the fields at daybreak, carrying with them their allowance for the day, which is eaten at noon; and their second meal is at night, after their labor is over—having worked, at the very least, six hours without intermission of rest or refreshment since their noonday meal."

The foregoing statement associates itself with what has been said in this work upon the connection of food with animal heat, as in sections 441 *c*, 1048–1050; and it is also an evidence of the fallacy of a prevailing opinion that a spare diet is productive of disease, and incompatible with laborious pursuits (§ 1048). I will add that this last subject is fully examined in the *Medical and Physiological Commentaries*, vol. ii., p. 691–698, in an article upon "*Fasting*."

NOTE PP.—THE DEVELOPMENTAL HYPOTHESIS.—THE DARWINIAN ORIGIN OF SPECIES.—"MEN AND MONKEYS."

The doctrine of the origin of species by transmutation, in all the aspects of that hypothesis, is abundantly refuted as to man by the distinctions which I have indicated between the Soul and Instinct (p. 892–906, § 1078); for, however great may be the coincidences between the organization and the functions of man and animals, there is none between absolute reason and instinct. The former, as I have shown, is peculiar to man. But, if there were any just foundation for the developmental doctrine, the manifestations of reason should not begin abruptly with man, but should observe some degree, at least, of correspondence with the physical conditions. And since, also, man is completely an animal in organization and functions, the ground which is thus obtained may be carried analogically throughout the animal kingdom.

Lest an advantage be taken of what has been said of the modification of Instinct in metamorphic animals (§ 1078 *p*), by applying the principle to the development of the rational faculties of man in his supposed evolution from the monkey tribe, it may be said, notwithstanding the obvious want of all analogy, that the mutations of organization in the metamorphic animals are of the most fundamental nature, while the corresponding modifications of instinct are always in strict conformity with the great general plan of instinct, and farther, also, that in all these cases the several mutations of structure and instinct are progressive stages of the same individual from the germ to its full maturity. Instinct, as I have shown in this work, is constituted throughout all the animal tribes with a sole reference to the uses of the body, and that no animal has been known to manifest any of the phenomena of reason that can not be resolved by the philosophy which I have predicated of instinct.

Glancing more particularly at the most novel of the repudiations of Creative Power, and which has taken captive so many of the scientific world, it appears to be encumbered with greater fallacies than any of its kindred doctrines. Besides the many obvious considerations of a physiological nature that apply to Darwin's "origin of species by natural selection" (p. 814, *note*), it is worth saying, that as all the assumed developments, or mutations of species as called by Darwin, start, at the best, with the infancy of animals (§ 1085), an objection which I alleged against the doctrine of spontaneity of beings in the work upon the "Soul and Instinct" (p. 158–165) is equally applicable to the Darwinian origin of species. The argument proceeds thus: Now let us see how far the statements of Holy Writ agree with what is manifestly fundamental in Nature. We are told, for example, that man and beast were created entire out of the earth; but had it been said that the materials of the earth organized themselves into living beings, or even that the materials were peculiar to living beings (an assumption highly probable, unless the composition had been revealed), the Narrative would be rejected by all as an imposture. Nay more, had it been affirmed that man was created in the condition of an infant, and thus left to grow up to maturity under the laws which govern his organization, without maternal sustenance and protection, without a ray of instinct, destitute of volition and muscular power, the personification of *helplessness*, the statement would be universally pronounced absurd.* Yet is this doctrine extensively propagated through the delusion that "the Creator endowed certain forms of inorganic matter with *the properties requisite to enable them to combine, at a fitting season, into the human or-*

* See my demonstration of the necessity of man's creation in a state of *maturity* both of mind and body, and all mammiferous animals, and all birds, in my work on the SOUL AND INSTINCT, p. 158–173. 1849. Also this work, § 1083.

ganism" (§ 350¾ at p. 187, 189, § 1083). What I have thus said as to the absolute exigencies of man in early life is as applicable to all mammiferous animals, and to all unfledged birds, in respect to the nature of their early food, who would, of course, immediately perish without the sustenance afforded by the parent.—ESSAY *on the Soul and Instinct*, p. 159, 160.—See *argument* in *Note* p. 815.

If it be objected by the advocates of Darwin's assumptions that the parent of the newly-developed species would have been the nursing mother, it will be readily seen that no animal, however much it may approximate man in organization, is in the least qualified to take charge of the human infant; a fact which may be applied, analogically, with equal force to the whole tribe of mammiferous animals, since, if it can be shown that man is an exception to any of the interpretations of nature that aspire at the origin of living beings the entire hypothesis necessarily falls.

In looking around for the species of animal out of which the human race has been developed, according to the scheme before us, that which approximates man most nearly in organization must enjoy the distinguished honor of paternity—the gorilla, orang-outang, or some one of the monkey tribe. It is considered that organization in these instances is so close upon that of man as to supply in this abstract sense a plausible pretense for a still closer relationship (§ 350¾ *kk*); and it follows, therefore, by the analogies of Nature, as well as by the law of inheritance, which is so justly argued by Darwin as the basis of his doctrine, that reason, the grand characteristic of the human race, should have also made some approximation in the gorilla or chimpanzee toward that divine attribute of man. But I have endeavored to demonstrate, in the article in this work upon the *Physiology of the Soul and Instinct* (p. 893–911), that no animal evinces that endowment, and that the whole tribe of apes, monkeys, and chimpanzees are vastly less provided with instinct than the honey-bee (p. 896–898, § 1078 *d*, *e*), while man dwindles into insignificance by the side of the orang-outang in respect to the instinctive principle (§ 1078 *q*, etc.). However great, therefore, may be the coincidences between the organization of man and the quadrumanous tribes, it is impossible to evade the fundamental distinction which is established by reason and instinct. But even in respect to organization there are some things which concur with reason in enforcing the conclusions to which it conducts us. Man, for example, walks erect; but that would not be sufficiently characteristic to prove the distinct and independent nature of his being. The absence, however, of all correspondence in the uses of his upper and lower extremities, while in the quadrumanous tribes they subserve the same purposes, does estrange them fundamentally from each other; and this argument is vastly increased by the fact that the arms of the human species are intended to fulfill the promptings of Reason, while the fore legs of the quadrumana are no more tributary to Instinct than the posterior legs—both of which are properly *legs*.

Nor will I leave this important subject till I array another argument against the so called "*typical* system" of development, and which will be seen, also, to operate against the Darwinian assumptions. It is this: The differences which occur between extinct and living animals and plants do not relate to organization as it respects *the life* of the being, but only to certain details in the form of organs. This difference does not involve, in the least, any difference in the plan of organization, which is exactly the same in the earliest of the lowest and highest order of beings, and throughout all the intermediate gradations in the ascending series, as at the present day. Composition, germs, growth, and reproduction are, also, common to all. Organic life, therefore, has always been precisely the same throughout every link of the vast chain, and *the physical agents of life, therefore, always the same* (§ 632 *b*). Hence it is evident that the whole typical system of theoretical geology, which is founded, not upon differences in the plan of organization, but upon the form of organs, is one of the greatest fallacies that has crept into science. Nor, indeed, could this speculation have pervaded the works of geologists any more than the recent novelties of Darwin, Huxley, etc., had any one of the numerous projectors been duly informed upon the science of Physiology. Anatomy supplies no foundation for this reasoning (§ 131, 1078 *e*); but, on the contrary, when associated with the physiological laws which it is designed to subserve, it is opposed to their conclusions (INDEX I., article *Design*).

The various attempts of arranging man in an order by himself upon the basis of physical characteristics appear to be open to objections; nor is this at all remarkable, considering the near affinities between the structure and physiological characteristics of man and certain other mammalia. The distinction founded by Professor Owen upon certain supposed peculiarities of the human brain would establish only a *specific*

difference. But even this has been controverted by Professor Huxley, who finally propounds the question, "Are we justified in classifying men and monkeys together? The comparison," he continues, "of the human skeleton with that of the gorilla, an orang, a chimpanzee, or any of the higher apes, will answer the question, and show at a glance the great resemblance and similarity there is between them (§ 1078 *e*). Now the gorilla, for example, is admittedly placed in the same order as the lemur, the cheiromys, and the galeopitheus, which differ far more from it than it does from man. Thus we can not but place them in the same order, or else all our notions of affinities and resemblances fall to the ground."

This presentation of the subject is plausible, and such as is anticipated in § 1078 *e*. It is at best, however, an artificial grouping of animals, without showing in the least that those which approach nearest in structure are not as perfectly distinct species as are the orang and the honey-bee, and not more allied to each other in their origin. But a common fallacy has beset all the attempts to establish man as a special order, under the artificial arrangement, that of neglecting the great facts which distinguish him essentially from every animal—his endowment with reason and his deficiency in instinct. Even the systematists, who have indicated peculiarities in the cerebral structure of man, have left the impression that reason depends upon those peculiarities. It is the error of materialism. But if the demonstration which has been made in this work of the substantive existence and self-acting nature of the soul and of the instinctive principle be true to Nature, it may be safely said that reason alone places man in an order by himself, whatever may be "our notions of affinities and resemblances" among skeletons (§ 241 *c*, *note*, 1078 *d*, *e*, *q*, NOTE C).

Finally, an argument against the hypotheses which ascribe the origin of species to blind material forces, and sufficiently conclusive as to man with all who believe in his immortality, may be founded upon that single fact, which so completely distinguishes him from the animal tribes. The same philosophy must obtain here as in all the suppositive conclusions of a physical nature, and it must be equally true that the soul of man not only originated, but became rational and *immortal* under the influence of those natural forces and laws which are supposed to have given origin to his material body—whether it have been according to the doctrine of Carpenter, Mülder, Tiedemann, etc. (§ 350¾ *f*, *l*, *m*), or as expounded by Professor Lewis (§ 1085, p. 922), or by the late projector, Darwin (p. 814, *note*). The first of these doctrines supposes that the elements of matter united into living beings in virtue of the forces with which they are endowed, and therefore, by parity of reason, the immortal soul of man must have had the same origin. If Creative Power be invoked for this particular difficulty, the physical structure and its life must fall under the same rule. There is no greater evidence of the existence of "vital properties in the elements of matter" than of the soul or instinct. But it is enough that the materialistic doctrine excludes all direct agency of Creative Power, and consigns the whole work to second causes. If that Power be allowed to have had any creative action in the production of organic beings, there can be no compromise with the hypothesis of second causes as it respects other parts of the same beings. While the Creator was employed about the immortal soul, it must be allowed that He would have equally attended to the no less difficult organization. A similar philosophy must apply, also, to the "parturitive" hypothesis (p. 922). And coming to Darwin's scheme of slowly progressive mutations, it is necessary that the animals in the advancing series out of which man was developed should have possessed not only a rational soul closely allied to man's, but that soul should be *immortal*. This unavoidable conclusion carries us back through all the ascending series of animals till we reach the "primordial cell" (§ 1051), or Darwin's "primordial form," for there alone can we look for the beginning of an *immortal* soul, according to the doctrine of the "origin of species by natural selection." How that cell or that soul came into being we are left in ignorance, as in the case of Tiedemann's "organic matter" (§ 350¾ *l*, p. 188). But if an *immortal* soul were not inherent in the cell, or at least in some animal anterior to man, it must have been a *supernatural* endowment of the human race, or, in other words, a special act of Creative Power, and therefore, also, by an irresistible logic, man's physical structure was equally a direct act of the same Power. This conclusion, it is true, requires the admission of man's spiritual immortality; and if it be objected to this that man is not thus distinguished from animals, I recur to my argument in proof of the perpetuity of the former and the extinction of the latter (§ 1079 *a*). But I do not consent to the exclusion of well-established Revelation from matters of science, and I therefore contend that the mission of Christ determines the resurrection exclusively in favor of rational and responsible beings.

Since, therefore, it appears from our premises that the soul of man is so contra-distinguished from the instinct of animals that it can have had no relation to the animal tribes, and that it follows, as a consequence, that man's physical organization was equally a direct act of Creative Power, and since, also, by common consent, he is on common ground with animals in his organization, it equally follows that the origin of every distinct species of animal was a special act of the same Power.

NOTE Qq.—HIGH ANTIQUITY OF THE HUMAN RACE.

Although this is not the place to discuss the question which has been much agitated of late among scientific men as to the high antiquity of the human race, or the proper interpretation or authenticity of the Mosaic narrative of creation, and other kindred topics, but to which, for special reasons, the author has adverted in this work (§ 14 *c*, 250¾ *l*, 632, 1051, 1079 *b*, 1083, p. 922–928, § 1085), he is led to repeat an objection which he alleged in his "Theoretical Geology" (§ 1079 *b*) against the supposed antiquity. The objection consists in the physiological fact that the human mind was alike endowed in the remotest past as at the present day, and is constitutionally so progressive that as soon as the race in any given locality exceeded in numbers the natural means of subsistence, they should have addicted themselves to the culture of the earth and other useful arts, and there should have thus descended to us from those early stages of society materials at least as advanced as those through which alone we learn the former existence of a vast population in the Western world. They should be also incomparably more abundant, since in the case of the geological man he is supposed to have been multiplying through hundreds of thousands of years; while the origin of the monumental vestiges of the race, of an unequivocal nature, lies within the compass of four thousand years, and the testimonials that have been recently produced in support of geological periods are insignificant in amount, and can not be shown to be of an earlier date than the Chaldean and Egyptian Architecture. Human reason, under equal circumstances, was as creative at its earliest dawn as at any later period, and the multiplication of mankind, according to the nature of climate and the progress of art, went on then as now. Science had not dawned when David, Solomon, Isaiah, and Homer wrote, and no better thinkers and writers have since appeared. Greece and Rome perfected History, Architecture, Oratory, Sculpture, Painting, soon afterward, and two thousand years more brings us to our own times. If, therefore, so much has been accomplished within the four thousand years beyond which we can not ascend, and such a host of brilliant minds contributed to the earliest page of history, what, I say, would not this same creative mind have produced had it been in operation ten thousand years before the structures, and sculptures, and writings of Babylon, Nineveh, and Egypt? It is now too late for the afterthought that the human mind has been subject to changes since the law of "natural selection," or any "law" within the compass of imagination, produced the physical organization of the race; and, moreover, what is known of the unvarying nature of Instinct in all species of animals determines the same stability for human Reason.

NOTE Rr.—LONG SENTENCES.

A sentence which occurs in section 638 has been very justly regarded as a "long one." Indeed, the Author concedes that it may require more than one sitting to read it through intelligibly. Its design may not be obvious to many, although it carries its own interpretation in showing the intimate relationship of the various topics involved, and which had been antecedently presented as the fabric of physiological medicine. That a system so complex and multifarious in its constituent parts, embracing the entire field of physiology and its applications to Pathology and Therapeutics, should be susceptible of exposition in a continuous sentence without violating the unity and harmony of a consistent whole, must be received as an evidence of the realities of its subject. But what has been now said is more particularly intended as a commentary upon the "long sentences" which abound in the Second Index, and which will be seen to embrace a variety analogous to the characteristic of section 638. The common nature of the subjects, under each article, brought them together into compact and continuous sentences, while, also, this congruity illustrates and confirms the harmonious system which is indicated in the first paragraph of these Institutes.

NOTES TO THE NINTH EDITION.

NOTE Aaa.—THE HUMORAL PATHOLOGY.—Dr. S. W. MITCHELL'S EXPERIMENTS WITH THE VIRUS OF THE RATTLESNAKE.—PROF. W. BOECK ON SYPHILIZATION.—VACCINATION.

The prevailing humoral pathology is so entirely subversive of all principles in medicine, whether they relate to pathology or therapeutics, and so opposed to physiological facts, that I am induced to refer again to this subject in its connection with the operation of poisons, and for the particular purpose of showing still farther, by the action of the venom of snakes, that it does not kill by any alteration of the blood, nor by any effect upon the important organs of life excepting through the destructive influences of the nervous power. This *note*, therefore, refers back to the numerous sections in which the laws of the nervous system are the subject of discussion, whether in their pathological or physiological aspects; but may be more particularly regarded as being a continuation of sections 494 *b-dd*, 828 *a-c*.

The facts to be first presented are derived from Dr. S. Weir Mitchell's very able Researches on the Venom of the Rattlesnake, published by the Smithsonian Institute. It will be seen that they fully corroborate the statements in the foregoing sections, and form, with many other examples presented in these Institutes, a ground of analogical reasoning as to the action of all other morbific causes upon the animal organism—displaying in a luminous manner the principles of vitalism and solidism, and pointing us with great significance to the magnificent laws of the nervous system.

Dr. Mitchell appears not to have been acquainted with the important experiments of Girtanner, for he remarks that no one but Fontana had tried the virus of snakes upon frogs; while the former overturned the experiments of the latter (§ 494 *b*). Mitchell's experiments are very different from Girtanner's, but the results are entirely harmonious.

In one Exp. the frog's heart ceased to pulsate in 3h. 10′ after the bite. "In 24 hours the muscular parts about the bite were almost diffluent, while the rest of the frog had no odor, or any other sign of putrefaction."

In another Exp. death took place on the fifth day after the bite. The muscles in the bitten part of the frog "were dark in color, and underwent extreme decomposition, while the rest of the body was not sensibly affected."

In another instance, where the bite was inflicted on the thigh of a frog, death took place in ten or twelve hours. "About the bite the muscular structure was almost diffluent, and could be torn with the utmost ease. A slight effusion of blood was found under both fore legs, in the axillary spaces. Elsewhere the organs were healthy."

In another Exp. death took place on the third day. "The bitten leg was literally soaked in blood, and was every where swollen by this local accumulation." No other remarkable signs.

The effect upon birds "was so sudden that where the dose of the venom was large there was hardly time to observe the resultant phenomena." "A snake four feet long bit a pigeon upon the knee." "Upon its being bitten, I threw it from me; but, to my surprise, it fell a dead weight upon the table, and did not afterwards breathe or move. Thirty seconds elapsed between the bite and the death."

A large rabbit bitten by a small snake died in one minute. "No lesion was found in any organ." "*The muscles and motor nerves* were perfectly excitable several minutes after death" (§ 1041).

In warm-blooded animals the rapidity of death was affected by the size of the animal. "A dog weighing 19½ pounds was bitten by several rattlesnakes, in six places at least. There were absolutely no marked symptoms in this case, except increasing weakness, vomiting, and movement of the bowels. The breathing then became jerking and labored. Death took place in three hours. The numerous bites were the most formidable lesions found after death." "Except some congestion of the vessels of the brain and its membranes, there was no morbid appearance in any viscus."

A dog weighing 15 pounds was bitten in two places, and died in 1h. 20′. "The

bitten thigh was a good deal swollen." "It was literally soaked with blood down to the periosteum, which was darkly stained." Brain, lungs, abdominal organs, healthy.

A dog of 12 pounds was bitten in two places by two snakes, "one biting him in the muscle and on the side." "The wound on the flank formed within two hours a prominent, almost pendulous mass, several inches long and wide." Death in five hours. "All the thoracic organs were normal. The heart as usual. The right side full of fluid blood, with some dark clots; the left side almost empty. Elsewhere the organs were healthy, excepting the kidneys, which were full of blood, and presented the appearance of acute congestion."

The morbid appearances of the solids were mostly limited, in all the experiments, to the bitten parts. As to the blood—"It was found, as a general rule, that it was most affected, and least coagulable, the longer the death was delayed." "A pigeon, for instance, is stricken; it droops, falls, and dies within thirty seconds. *The blood is red and coagulates perfectly. Its corpuscles are ideally healthy.* In such a case no physiologist would impute the death to the altered blood"—and certainly, therefore, in no other case, whatever may be the morbid appearances of the blood (§ 845–847).

Finally, here is an *experimentum crucis*—"*Two drops* of venom were added to *one drop* of pigeon's blood. Coagulation took place within four minutes"—and so of other like experiments. "It becomes clear," says the author, "from these results, that the mixture of venom and blood does not alter the vital fluid at first in any way which is appreciable by the senses. It clots as firmly as usual. After a time, however, the clot softens." "In primary or acute poisoning I have never been able to detect the least alteration in the blood-cells." But when death comes on slowly, or, as the author calls it, "in chronic or secondary poisoning, the case," he thinks, "may with propriety be then referred to the incipient putrefactive changes which affect the blood, as well as to the continued influence of the agencies which first depress the heart's action, and destroy nervous function." But, it is added—"we are still far from knowing why, or precisely how, this or that structure is affected."

All the results of our author's experiments refer us to the local action of the poison for the constitutional results; and so far from any early destruction or even depression of "nervous function," there was a strong development of the nervous influence, as shown by the rigor of the muscles in some of the experiments, and by the well-known convulsions that occur in the experiments of others (§ 828 *b*). In one of our author's cases, that of a rabbit, we have seen that he remarks that "the muscles and *motor nerves* were perfectly excitable several minutes after death." This phraseology, however, of destruction or depression of nervous function is very common when just the reverse of it is the case, and where, as in our author's experiments, the alteration or destruction of the organic functions is owing to an exaltation and modification of the nervous influence (§ 225–232, 826 *cc*, 894–896, 902, 905 *a*, &c.; INDEX II, article, *Nervous Power*). Nor does our author show that there was any sign of putrefaction of blood in any of his experiments. But if it be admitted that such was the fact, it was manifestly the result of the morbid state of the solids; and for a farther exposition of which I would refer the reader to sections 516 no. 6, 845–847, 905 *a*, which will serve as a guide to many other sections where the philosophy of the subject is considered.

What has been now said relative to the venom of the rattlesnake is not alone for the purpose of giving greater effect to the statements upon the same question in former sections of this work (§ 494 *a–e*, 845–847), but to contribute its light toward the true interpretation of the *modus operandi* of the hydrophobic virus, of the virus of the "dissection wound," hydrocyanic acid, strychnia, veratria, aconitina, &c., which present close analogies to the *modus operandi* of the venom of serpents, and for the philosophy of which as expounded in this work the two Indexes may be consulted under those several denominations. By these strongly-marked examples, as I have endeavored to show in a great variety of ways, and very extensively throughout this work, we may be aided in our interpretation of the *modus operandi* of all other morbific causes, and of all remedial agents, and be thus enabled to consign more and more nearly to oblivion that stronghold of empiricism and the great incubus of Medicine, the *Humoral Pathology*.

I would say, in conclusion, that notwithstanding the interesting nature of Dr. MITCHELL'S Experiments, the question as to the *modus operandi* of the virus of snakes was more distinctly and conclusively settled long ago by a single experiment made upon a frog by GIRTANNER (§ 494 *b*).

SYPHILIZATION.—Whatever objections may exist against Professor W. BOECK'S

method of treating syphilis by inoculation, it has been well ascertained to be as successful as other modes of treatment. "The value of syphilization as a curative method has been a subject of long discussions in the Medical Society of Christiania, occasioned by Dr. Holst's report of Dr. Lane's and Dr. Gascoyen's views of Professor W. Boeck's experiments with syphilization in London, 1865." At a late meeting of that very enlightened society (1869), a great amount of statistical information, from the most reliable sources, was produced; from which it appears that the success of the treatment is well established.

The particular bearing of this subject upon the humoral pathology is the principle which it carries with it in behalf of solidism. As is well known, syphilis is slowly extinguished by repeated inoculations upon the upper and lower parts of the body. If the disease, therefore, were dependent upon the state of the blood, or any imaginable "humors," its removal should be as readily effected by a large number of inoculations of the upper parts of the body as by dividing the number between the upper and inferior parts. On the contrary, however, when the entire number of inoculations, which are sufficient to extinguish the disease if divided between the upper and lower parts, are made wholly upon one or the other, that part which is avoided remains susceptible, and the disease is not eradicated (§ 76–80, 545, 657 *a*, 902 *i*).

VACCINATION.—Parallel with the foregoing is a case of small-pox vanishing under vaccination, which occurred in a family whom I was attending. On the third day after the mother had given birth to an infant she had a severe attack of varioloid, which left no doubt that the child had contracted the small-pox *in utero* (§ 836). I immediately vaccinated the infant in several places, and on the following day it broke out with the small-pox. Both diseases advanced regularly till the seventh or eighth day, when the pustules of the small-pox, with which the body was thickly covered and confluent on the face, suddenly dried up, and were thoroughly exfoliated in two or three days. No scar was produced. The vaccinated pustules went on through their regular stages, forming the usual scabs and marks.

NOTE BBB.—CAPILLARY HEMORRHAGE.

The subject of hemorrhage derives its principal importance from its significance of the pathological conditions in which it originates, and therefore from its bearing upon the treatment. This is especially the case with hæmoptysis, hæmatamesis, and purpura hemorrhagica, in which affections I have endeavored to show that the hemorrhage is not owing to any rupture of the vessels, but is the result of a morbid process analogous to secretion, and indicative of an inflammatory or congestive state that demands an antiphlogistic treatment instead of the prevailing stimulating plan. Hæmoptysis, whether as attendant upon pulmonary phthisis before ulceration has occurred, or upon pneumonia, is Nature's remedy, and were this indication followed, we should not continue to record the fearful mortality from those diseases to which I have already called the attention of the reader (§ 890 *a–h*, 922, 984, 1018–1019; NOTE MM, p. 1141; and extensively in the MEDICAL AND PHYSIOLOGICAL COMMENTARIES, 1840, chapter on *Venous Congestion*). In this view of the subject, there is no question in practical medicine of greater importance (*see* INDEX II., article *Hemorrhage*). But the object of this *Note* is more particularly to say, that no investigations have yet disturbed my position as to the source of the hemorrhages; and as a corroborating proof of this, I may quote a late paragraph from a high authority. Thus—

"Dr. RASMUSSEN, in his valuable paper, shows that, extensively as the subject of hæmoptysis, especially in connection with pulmonary phthisis, has engaged the attention of investigators, the source of these hemorrhages, the absolute demonstration of *the vessel or vessels* whence the blood has come, has almost entirely failed."—*Brit. and For. Med. Chir. Rev.*, Jan., 1869.

NOTE CCC.—INFLAMMATION OF THE BRAIN.—CEREBRO-SPINAL MENINGITIS.

Many writers in Europe and America have lately contributed their experience in relation to the disease which has acquired the designation of *cerebro-spinal meningitis*, though a difference of opinion exists as to its local or constitutional nature. That

inflammation of the brain and spinal cord, particularly of the former organ, is constantly met with as a local disease, can not be doubted. But the malady is often showing itself in connection with idiopathic fever (§ 712, 757 *a*), particularly when fever prevails epidemically (§ 779); and there is much reason to believe that, in a general sense, when cerebral inflammation occurs epidemically, it is an incident of constitutional or idiopathic fever, as when pneumonia prevails epidemically, and of which latter complication several authors have given a history. That by Cleghorn, an abstract of which occurs at pages 757–759, is well worthy of the reader's attention, not only for the light which it reflects upon epidemic cerebro-spinal meningitis, but for the admirable experience in the treatment of the pneumonic complications. But whether the cerebro-spinal inflammation be simply a local affection or complicated with idiopathic fever, it is the local condition to which the treatment should be mainly directed, and this treatment should consist chiefly of large abstractions of blood. Whatever may be the prostration of muscular strength, or "debility" as it is called (§ 487 *h*, 569, 887, 961–964), the patient will soon be invigorated by copious bloodletting, as in Cleghorn's cases of pneumonia (§ 1005 *h*), or in Jackson's cases of cerebral inflammation complicated with prostrating idiopathic fever (§ 992 *b*), or as related by many other masters in the healing art whose experience is presented in this work in the article on Loss of Blood. The failure of the remedy in the hands of those who have adopted it is owing, as Sydenham well says, "to bleeding in an improper manner," which means, according to Botallus, that "bleeding does no service in many cases, either because persons have recourse to it too late, or use it too sparingly, or commit some error in both these particulars" (§ 1000, 1001 *a*). Although large abstractions of blood are indispensable in the prostrating forms of epidemic pneumonia (§ 1005 *h*), puerperal fever (§ 1005 *a–g*), plague, yellow fever, and so-called "putrid fevers" (§ 1002–1004, NOTE FF, p. 1135), in cerebral inflammation the exigencies for the remedy are greater, and the system is enabled to sustain greater losses of blood than in any other malady, and for reasons explained in sections 974–979.

The fatality of "cerebro-spinal meningitis" has been so great in recent times, that we may look for an early abandonment of the stimulating treatment, and a return to the successful practice of our predecessors. Indeed, already we begin to hear of bloodletting and its useful effects, particularly as practiced in France. Thus, a writer in the *Medical Times and Gazette* of May 25, 1867, remarks that—"In the French epidemic *large bleedings*, in the early stage of the disease, were the *only means of treatment attended with success.*"—It may be safely stated that in the epidemics of this disease during a few late years more than three fourths of the subjects have perished when bloodletting has been neglected. That the disease is of the most intense inflammatory nature will not be doubted, even by those who recognise no other test of inflammation than its physical products. These are abundantly set forth by those who have made extensive anatomical investigations. As an example, it is said by Dr. Sanford B. Hunt that—

"Of 68 autopsies, the records of which have been examined, all present positive evidence, not only that the meninges of the brain and spinal cord were the localities of inflammatory disease, but that the sufferers died from the inflammation, and not from any intercurrent or other disease. The appearances in the other organs were mostly negative." The vital signs were such as distinguish the worst forms of cerebral inflammation.

NOTE DDD.—CORRELATION OF PHYSICAL AND VITAL FORCES.

In what has been said specifically upon the subject of *Correlation of Physical and Vital Forces* at page 921, it was simply intended to bring to the reader's attention the ample discussion of the relation of the vital force to organic heat which extends from page 234 to 279, and where the vital force is variously contradistinguished from animal heat, and the latter shown to be only one of the numerous products of the former in its operation through organic structures. In the progress of that inquiry numerous facts are also presented—such, for example, as relate to the nervous influence, which prove incontrovertibly the absolute independence of the vital force of all other forces. But the discussion of the function of calorification embraces only a very limited array of the Author's arguments against the identity of the vital force with those of physics and chemistry, or their conversion into each other. All that the Author has said upon the composition and structure of organic beings, all upon

the properties of life, all upon the nervous influence and laws of the nervous system, all upon the organic and animal functions, all upon the principles relative to pathology, therapeutics, and the modus operandi of remedies, forms an unanswerable demonstration against the doctrine of Correlation or Equivalence of Forces. It will be seen, therefore, from the foregoing references, that a greater part of this book is in direct opposition to the doctrine.

The advocates of that doctrine must also identify the intellectual part of man with the common forces of matter, and, from the obvious analogy between the human and Divine Mind, with God Himself. This they do, not only impliedly, but by a direct advocacy of materialism, and not seldom by an avowal of atheism. This I shall show extensively in the enlarged edition of my work on the Soul and Instinctive Principle, to be soon published by the Messrs. HARPER & BROTHERS, and where, also, may be found a critical examination of the doctrine of the Correlation of Forces in its application to the Life of organic beings, and to the Soul.

One of the plausible consequences of that doctrine, and which is brought to their mutual support, is the assumed identity of certain artificial compounds and the simple transformations out of organic substances which have been generally supposed to retain their organic constitution; and which will be farther considered in NOTE FFF.

NOTE EEE.—SUPPOSED IDENTITY OF THE NERVOUS POWER AND ELECTRICITY.

The mechanical theorists who had supposed that they had settled experimentally the identity of the nervous power and electricity, having from other experiments concluded that the nerves convey their influence, whether motor or sensitive, at the rate of only about 90 feet in a second, and having thus abandoned the electrical hypothesis, have presented a serious obstacle to their doctrine of the correlation of forces. It is equivalent to an admission that there is nothing in inorganic nature that will in the least interpret the phenomena relative to the nervous system, and that we must therefore seek for a solution of the problem in the phenomena of life and independently of artificial contrivances (§ 234 *e*, 409 *k* and *references* there, 893 *a*, NOTE Y).

NOTE FFF.—SUPPOSED ARTIFICIAL PRODUCTION OF ORGANIC COMPOUNDS. (See Article on *Composition*, p. 23–49).

The numerous productions out of inorganic substances which have lately proceeded from the laboratory of the chemist in imitation of simple transformations out of organic compounds, require only a very brief notice. In the first place those transformations are the results of artificial influences, the very object of which has been to institute changes in the original compound, as in the production of morphia, quinia, alcohol, &c. These substances, therefore, have, doubtless, been more or less diverted from their organic constitution by the reagents employed, although they may have been as simple as heat, or atmospheric air; and what renders this certain are the alkalescent nature and crystalline structure of quinia, morphia, cinchonia, &c. Indeed, some of these reputedly organic compounds may be made to undergo an apparently endless variety of transformations; such, for example, being the case with alcohol when subjected to the action of certain acids throughout its various changes. It is not remarkable, therefore, that apparent imitations of some of these things should have been made out of inorganic substances. But what reliance can be placed upon the supposed organic nature of these chemical compounds? Some of the best authorities, as we have seen—LEHMANN for example—assure us that analyses of organic compounds are not reliable (p. 789–794, § 1028–1033). Nevertheless, the supposed organic constitution of those purely artifical productions is too important to the doctrine of the Correlation of Physical and Vital Forces to be surrendered without a struggle on the part of the materialists. In that struggle they must encounter the fact that no organic compound has yet appeared as the natural product of the forces and laws of inorganic nature, and that even animal organisms are incapable of organizing the simple elements of matter or their inorganic compounds. Nothing but plants have been able, in a solitary instance, to form an organic compound out of inorganic substances. This is the great function which devolves upon them, and for the manifest purpose of supplying food to the animal kingdom (§ 1052). Hence it is not probable that the chemist will ever succeed in his aspirations at becoming Na-

ture's journeyman. Looking, therefore, at Nature alone, I ask the materialist whether it is probable that his favorite Nature, which, he concedes, "operates by uniform laws," would have been so inconsistent as to have ordained the vegetable tribes for the universal purpose of organizing the elements of matter for the sustenance of the animal tribes, and at the same time have so endowed the elements of matter as to unite into organic compounds, in virtue of their own inherent properties, whatever physical influences may be brought to operate upon them; while, at the same time, she has denied to animals the ability which is so lavishly bestowed upon the vegetable world? Moreover, if you can discover no difference between the Force which animates the organic kingdom and the forces of external nature, do not the fundamental distinctions between the *organic structure* of plants and all the supposable conditions of the *elements of matter* under every imaginable influence pronounce the impossibility of effecting by any artificial processes the compounds which are the work of vegetable organic structure, and then only through an elaborate series of organs which are *every where distinguished by consummate designs all working harmoniously together for this very result?*

As animals can not be nourished by inorganic matter, there remains to the chemist an important test—try the supposed organic compounds derived from unequivocal inorganic substances as food for animals, and should they prove a means of sustenance a great triumph will have been obtained for the doctrine of the Correlation of Forces; while, on the contrary, should failure ensue, Chemistry will as modestly retire into its vast domain—the mineral kingdom (§ 1052). And yet another test; try a supposed compound like quinia and morphia, made from the elements of matter, as remedial agents, and if the former will cure intermittent fever, and the latter procure sleep and relieve pain, they will prove a great acquisition to the Materia Medica.

Finally, the eminent VIRCHOW, who is deeply interested in the manufacture of something approximating the simplest forms of organic substances, tells us that—

"Chemistry has not succeeded in forming a *blastema* [the general formative element of tissues] nor physics in forming a *cell.* What does it matter?"—See my work on the SOUL AND INSTINCTIVE PRINCIPLE, edition of 1870, where this subject is discussed in that relation.

NOTE GGG.—BLOODLETTING VERSUS STIMULANTS.

As might be anticipated from the results of the stimulating treatment of inflammations and fevers, a reaction has been taking place for a few late years, even among its strongest advocates, both in this country and in Europe. It has again had, along with its universal pathological principle "debility," its "temporary day." And where will its advocates be in the future annals of medicine? Perhaps an answer may be found in the remarkable fact in relation to *Bloodletting* in the treatment of inflammations and fevers—that there *is not one individual* in the history of medical literature who has contributed to the improvement of medicine, or whose writings have survived his own generation, that has not declared bloodletting to be the principal remedy, in a general sense, for those diseases, and always so in pneumonia, pleuritis, phrenitis, enteritis, articular rheumatism, puerperal fever, congestive fevers, &c. (§ 1005½ *a*, 1006 *g*). If there be *one* exception, it has escaped my knowledge. It is in respect to the stimulating treatment of disease and the doctrine of *debility*, as with the efforts to carry Organic Chemistry into physiology and pathology (see p. 203, § 376½). All this has been due to the simply practical character of the age, in which the senses have had the lead of the understanding. And may we not confidently affirm that such a dispensation awaits the projectors of the doctrine of the "*Correlation of the Physical and Vital Forces*"?

Finally, I may speak of the results of bloodletting in my own practice; not, however, according to the usual "numerical method," but will simply place it upon record in behalf of Medicine, in addition to my statement as to croup (§ 1058 *p*), that after an unintermitting practice of fifty-four years I have never failed of abstracting blood in enteritis, pneumonia, phrenitis, pleuritis, and puerperal fever, and with rare exceptions in erysipelas, both in their simple and complicated forms, and that I have never lost a patient affected with either of the last three diseases, two only of enteritis, one of phrenitis, and one only of pneumonia (a child of three years in 1818), and this last, in my judgment, from insufficient bloodletting (§ 973–980, 1058 *q*).

THE END.

THE

INSTITUTES OF MEDICINE.

By MARTYN PAINE, A.M., M.D., LL.D.,

Professor of the Institutes of Medicine and Materia Medica in the University of New York; Author of the "Medical and Physiological Commentaries," "A Treatise on the Soul and Instinct," "Therapeutics and Materia Medica," etc., etc.; Corresponding Member of the Royal Verein für Heilkunde in Preussen; Corresponding Member of the Royal Medico-Chirurgical Academy of Turin; Corresponding Member of the Gesellschaft für Natur und Heilkunde zu Dresden; Honorary Member of the Imperial University Physico-Medical Society of Moscow; Member of the Medical Society of Leipsic; of the Medical Society of Sweden; of the Montreal Natural History Society; and of many other Learned Societies.

With a Portrait. New Edition, Revised and Enlarged, with a Copious Index.

The Publishers, in offering to the profession a New and Enlarged Edition of Dr. Paine's Institutes of Medicine, avail themselves of the opinion of the Medical Press in behalf of the work, and subjoin numerous extracts from late periodicals. Some of the extracts bear upon a controverted question, but the Publishers are not disposed that their copyright shall suffer by any abstraction from the merits of the work; and that the latter may go forth under unquestionable authority, they have made the extracts of unusual length. As a prophet, also, is said to be without honor in his own country, the Publishers are disposed to show that exceptions occasionally arise, and that this may be the more apparent, and as they are content withal, they limit the extracts to *American* periodicals; or, rather, do not await the arrival of Foreign Notices of this Fourth Edition of the Institutes.

October 8, 1853.

From the New York Journal of Medicine, May, 1858.

"The *Institutes* is full of learning and philosophy, and the reader, while impressed with the profound erudition of the author, can not but be amazed at the amount of labor the book discloses. * * Professor Paine is engaged in a struggle for truth. His mind is concentrated upon the elimination of facts, and in the pursuit of what he deems right he seeks not the applause of his contemporaries. He knows full well that principles must and will survive the disputations of the controversialist. * * He is, in every sense of the word, a medical philosopher, a devotee of science, and a commentator whose opinions will not only pass to posterity, but receive the high tribute to which they are entitled. Inflexible in his convictions of truth, he can not be moved by friend or foe—and he pursues his onward course with an earnestness and zeal characteristic of the man. * * We can confidently recommend the Institutes both to the practitioner and student of medicine; to the former it will be a rich treat—it will open to him the wide and fruitful field of medical science, and he will see elaborated in it the great and leading questions which have so long constituted the basis of controversy among the learned in our profession. The latter will find it a treasury of knowledge—a veritable encyclopædia—full of the prominent facts of his science; and its tendency, moreover, will be to induct him into habits of thought and reflection. Lastly, we may be permitted to say that the article on the 'Rights of Authors' has been elicited by what Professor Paine deemed an infringement upon his claims; and he has entered upon the subject not only with zeal, but, in the language of the law, he has made out his case by a chain of very positive evidence."

From the same Journal of July, 1858.

"There is no where to be found in medical literature, nor in all medical works extant put together, so full, so complete, so accurate an exposition and elucidation of the functions, and the paramount importance of the *ganglionic* system in influencing all the organic functions (including *secretion*) physiologically and pathologically, as is contained in the 'Institues' and other writings of Dr. Paine. An examination of the *Index* of the 'Institutes' alone will prove this. Fifty such essays as that of Dr. Campbell could be compiled from the 'Institutes,' and then leave material, facts, and illustrations enough for as many more, all embodying and setting forth the same doctrines. * * The author of the 'Institutes' and of the 'Medical and Physiological Commentaries' can well afford to bide his time. His fame is secure. It will grow brighter with time. The profession will delight to cherish it and to do him honor. They will not allow a single particle of his just merits to perish, or to be appropriated by others. Posterity will vindicate all his just claims and assign his rank among the great minds of our country. But few properly appreciate, or are even acquainted with the extent of his Herculean labors. None but those who have labored in the same field can justly estimate the vast range of his learning.—C. A. L."

From the American Medical Gazette, New York, June, 1858.

"That the 'Institutes of Medicine' and the 'Medical and Physiological Commentaries' are characterized by great analytic power, profound philosophy, rare genius, and unsurpassed learning, no candid reader can deny; that they will rank with the foremost works in our science, and entitle their author to a high rank among the greatest men in medicine, will hardly be disputed. * * In the late Appendix to the Institutes many important subjects are discussed with the usual acuteness and ability of the author. The Index, of 175 pages, may well be called a *model index*, as it contains a brief summary, as it were, of the entire work."

The September Number of the foregoing journal contains a forcible and triumphant article of thirteen pages, by Professor C. A. Lee, in defense of Professor Paine's claims of originality in elucidating and applying what is designated as the "excito-secretory function of the nervous system," and showing that the term itself has been derived from his Institutes of Medicine. We quote the following:

"Dr. Paine claims, and very justly, as may be seen by our extracts, a long priority in designating the nervous mechanism through which the secretions are physiologically influenced; and although he has not thought it worth his while to insist upon his priority in the small matter of bestowing a name upon the function, we have shown that he suggested the very name which is now apparently conceded by nearly all the medical periodicals in this country to form the only originality belonging to Dr. Campbell. But what is alone of any importance, Dr. Paine was not only the first, but still the only one to carry the 'excito-secretory function' and all the physiological laws of the nervous system into pathology and therapeutics. * * But Dr. Paine regards the *excito-secretory* function of the nervous system as a very minor part of the influences of that system, the most important of which is its variously alterative effects upon the organic functions; or, in his own language, 'in all the cases the nervous power is rendered *stimulant*, or *depressant*, or *alterative* to the organic properties and functions, and variously energetic, according to the operating cause, and the intensity and suddenness with which it may operate."—p. 107.

"The whole of this disputation has had its origin in a mere pretense that has grown out of a name. *Excito-secretory function* is the magic word which is made to engulph the whole philosophy that concerns the labyrinth of the organic functions in their connection with the nervous system. But it is a word of such partial import as not to convey the slightest connection with pathology and therapeutics; but, on the contrary, to impress the belief that it is limited to the natural state of the body. It disregards all the modifying influences of the nervous system upon organic actions and their products, whether induced by remedial or morbific agents; and the inappropriateness of the term, beyond its mere physiological import, may readily be seen should any one attempt its introduction into any of the pathological or therapeutical branches of Dr. Paine's Institutes of Medicine."

From the Virginia Medical Journal, July, 1858.

"In these degenerate days, when all men bow to the sway of public opinion, and are more prone, alas, to be ruled by policy than to follow the guidance of reason and judgment; in these latter days—when the voice of the people is the voice of God, we, at least, should not withhold our praise from him who fears not to stem the current of popular opinion, and who strikes a bold blow in defense of the right. However we may wonder at his hardihood, and hesitate to follow his rash example, we involuntarily admire this uncompromising devotion to his own doctrines, and respect the courage we are too timid to imitate. The author of the work we have now under consideration is emphatically such a man as we have endeavored to describe. At a period in the history of medicine when the mind of the profession is running like a torrent under the guidance of Andral, Louis, and the other brilliant leaders of the pathological anatomists, into the humoral theory of disease—when, too, the reaction against the heroic school of medicine had reached to such an extent as to favor the rise and temporary success of the infinitesimal dogma, and, more important than all—when the progress of organic chemistry is startling the minds of men with its bold innovations and brilliant theories in physiology and pathology, it was then that Dr. Martyn Paine, almost alone, with nothing to support him save his indomitable energy, his great learning, and his intrepid heart, stood up before the medical world in defense of the waning school of vital physiologists and the time-honored solidism of Stahl and Hunter—when medicine expectanté was most triumphant he still advocated blood-letting and the administration of remedies on the heroic plan—when Liebig, Thompson, and Lehmann unite in leading the student through the attractive investigations and plausible theories of zoochemistry, Dr. Paine still gallantly defends the creed of Bichat and the vitalists against all comers, and charges boldly and effectively upon the ever increasing ranks of the humoral pathologists.

"It is justly due to this learned and zealous investigator and medical philosopher to say that we do not believe there can be found another man in America who would have waged this unequal war for so long a time and with such signal ability; and although we doubt whether many of our readers have ever devoted time enough to his various books, tracts and essays to enable him to do justice to his labors in medicine, yet we will point to every thing which has emanated from his pen as being characterized with an amount of learning, profound reasoning, and a power of resistance equal to the emergency. * * We can not but be astonished at the amount of ground traveled over by this zealous student, and we may point him out to the young in the profession as a noble example of what may be accomplished by those who will imitate his industry and perseverance after knowledge."

The August Number of the foregoing journal contains the able article to which reference is made under our extract from the New Hampshire Journal of Medicine.

From the American Journal of the Medical Sciences, Philadelphia, July, 1858.

"Dr. Paine's Institutes of Medicine presents throughout ample evidence of the general erudition of its author, his habits of close investigation, and his intimate acquaintance with the subjects of which he treats, and with the views entertained by others in respect to them. A degree of originality and independence of thought pervades all his teachings, whether these have reference to the vital conditions and functions of the human organism, the laws by which they are governed, or to the nature, causes, and tendencies of disease, and the curative measures by the agency of which this may be best conducted to a favorable termination.

"The Institutes of Medicine as presented by Dr. Paine, whether we receive them as true, or reject them as false, are, nevertheless, based upon a truly philosophical investigation, aided by all the accumulated light derived from the observations, experiments, and reasoning of preceding and contemporary authorities, of the physiology, pathology, and therapeutics of the human subject.

It is, we confess, somewhat cheering to meet with one of the high intellectual endowments of Dr. Paine, who, at the present day, when the doctrines of physiologists, pathologists, and therapeutists are alike verging into materialism—when the organic functions, at least, of the animal organism are all referred to a mere modification of the same action and reaction which occur in brute matter, has sufficient courage to raise his voice in defense of the vitality of the system; in recognition of the fact that our or-

gans are built up and maintained in a healthful condition for the regular performance of their appropriate functions by a principle which we denominate life, and by which the material elements of the animal organism are almost entirely removed from out the control of those merely physical laws to which, as dead matter, they would necessarily be subjected.

"We consider the treatise to be one well worthy of an attentive study on the part of every advanced student and practitioner of medicine, to whose notice we earnestly recommend it. Although far from being inclined to indorse the accuracy of every doctrine advanced by the author, nor the chain of reasoning by which he attempts its support, we are, nevertheless, convinced that his prelections, from the amount of truth set forth in them, and the *vitality* by which they are pervaded, if they do not actually convey sound views on every thing that relates to the philosophy of medicine, can not fail to lead at least to a correct basis for the establishment of such views. The strong conservative predilections of Dr. Paine, which induce him to subject every new observation and theory in medicine to the severest scrutiny, and to refuse its admission until positively established, can have no other than a favorable influence upon his readers, by teaching them to be *progressive* only in the road of positive truth.—D. F. C."

From the North American Medico-Chirurgical Review, September, 1858.

"No one can read the *Institutes of Medicine* without being filled with respect and even admiration for the profound erudition, the painstaking and systematic research, and the laborious reflection exhibited so abundantly in its pages. With careful and discriminating hands Dr. Paine has gathered together, from the writings of both the earlier and contemporary physiologists, the numerous important facts and details which constitute the subject-matter—the crude material—so to speak, of his favorite science, and arranged and built them up into a stately edifice—the Institutiones Medicinæ—whose great corner-stones are Physiology, Pathology, and Therapeutics. We conclude our remarks by earnestly recommending his work to the careful perusal and study of every one interested in physiology, whether in its aspect of a pure or an applied science. The breadth and comprehensiveness of many of its doctrines, the great questions in which it abounds, and the consummate skill and learning with which these are generally treated, stamp it as a valuable treatise which should find a place in every philosophical library and be consulted by every physician who practices his profession as a science and not as an empyrical art."

From the Medical and Surgical Reporter, Philadelphia, May, 1858.

"Dr. Paine gives us two very copious Indexes and an Appendix to his Institutes of Medicine, and we find throughout the work constant references from page to page to facilitate the task of the student in acquiring a complete knowledge of every subject. Finally, as a postscript, he details in full what he claims as his own, and we think we can not do better than lay his claims before our readers.

"In his Preface to this fourth edition Dr. Paine says: 'This work, originally published in 1847, remains without change, as the author has seen no reason to modify any of his doctrines.' But in his Appendix he does ample justice to all subsequent discoveries in physiology and chemistry. He says: 'Whatever may have been subsequently disclosed in physiology and chemistry is essentially in harmony with all that the author incorporated in the foundation upon which his Institutes are erected, and places them beyond the probability of being much invalidated. In his discussion of organic chemistry as applied to physiology, pathology, and therapeutics, it is evident that he could not doubt that this invasion upon medicine would prove ephemeral, and that the chemist would soon retreat into the appropriate field of nature.'

"He reviews very thoroughly all the evidence connected with this statement, and certainly shows good logical reasons for his views."

From the Charleston (S. C.) *Medical Journal and Review*, July, 1858.

"Few men have labored more constantly, more earnestly, and with more singleness of purpose than the venerable and learned author whose late edition of the Institutes of Medicine now lies before us. * * The arrangement of the work is exceedingly systematic and satisfactory. Step by step the reader is led on from the study of the functions as they exist in health to the causes and consequences of their derangement, and to the methods of treatment adapted to them.

"Professor Paine's style is at once vigorous, bold, and classical. Stating in few words the thought which he would convey, he does so in such a manner as not to allow it soon to be effaced. His writings are every where characterized by perspicuity and terseness; and if his meaning is not understood (as may often happen) it is not due to the faulty expression of it, but to the fact that he deals with subjects of great depth and difficulty of comprehension—beyond the span of many minds, above the reach of all, unless close attention and undeviating thought be given to their study. The reader may at first find some difficulty in following the writer, but he will soon become accustomed to his style, and read with interest and facility."

From the Boston Medical and Surgical Journal, May, 1858.

"One can not fail, in reading Dr. Paine's Institutes of Medicine, to be struck with the immense industry of the author, with his originality, and with his consistency; and if we must differ from him in some of his views, we do so with the diffidence due to a learned and conscientious teacher."

In a subsequent Number (July 29th) it is said by "W. E. C." of Dr. Paine's Medical and Physiological Commentaries:

"The first peculiarity of Dr. Paine that arrests us is the solid, methodical manner in which he plants himself at his work—the thorough *à plomb* which he establishes for himself before he grapples with his subject-matter. You feel assured of this in the first ten lines you read. It is not going to be any trifling affair, you are at once convinced. It is a brawny student of the old very old sort you have got into companionship with, and if you wish to keep his company you must buckle yourself closely to the matter before you, and set yourself to hard work.

"The scope he has taken is our next point of note. This is not only shown by allusions and casual references in the text, but the foot of almost every page in the book has quotations, with chapter and page, from apparently every work that can possibly illustrate the subject or enforce the writer's views, including not only accredited books, magazines, and monographs in our profession, but those from every walk of literature, giving us a high opinion of the author's cultivation of pursuits too often neglected by medical

men. These are used, too, not, as is often the case, simply to set off the text and suggest ideas of the research of the writer, but as genuine illustrations either of the matter in hand and the peculiar view of it taken by the writer, or of the mental temperament of the time in which the doctrine or its converse was first propounded. In short, the book is not that of a sciolist, by a great deal, but of a thorough and strong scholar, from a very contact with whom strength and refreshment may be derived, even if difference of opinion should exist and remain after it.

"As we have said, it is impossible to review here such a work as Dr. Paine's, but we may give an idea of some of its contents, &c., &c.

"A Dissertation on the Hippocratic and Anatomical Schools, and another on the writings of Louis, conclude the second volume. The last paper is as remarkable and as characteristic as any thing in the two volumes; of and in itself it shows fully the scope, power, and variety of the scholarly Author. We will not comment upon it, but earnestly recommend a perusal of it, and in return for our good advice would only like to watch the countenances of certain friends of ours well engaged in the recreation."

From the Montreal Medical Chronicle, September, 1858.

"No one can peruse these volumes of Dr. Paine (the Institutes and Commentaries) without being forcibly impressed with the vast amount of erudition displayed by the learned Author. Every page bears witness to an extent of reading and research really surprising. It is not only the standard medical works in various languages that he has consulted, but periodical literature has been thoroughly ransacked to discover new thoughts, truths, and experiments in support of and bearing upon the peculiar views he advances.

"As we agree in the main with the vitalists, although differing from them in some respects, and as we admit the vast importance of much that is taught by the zoo-chemists, we shall endeavor to give our readers, in as few words as possible, the view we take of life."

From the Buffalo Medical Journal and Review, September, 1858.

"The Institutes of Medicine first saw the light at a time when the humoral and chemical doctrines of life were in the ascendancy, and when vitalism was scouted as an obsolete relic of bygone ages. But now, when the opinion begins very generally to prevail, that the physical doctrines of life will not suffice for the satisfactory solution of the varied phenomena of organic beings in health and disease, nor for the explanation of the *modus operandi of remedies*, there is evidently a commencing reaction in favor of the doctrines of vitalism; and this work, and the 'Commentaries' of our author, begin to be sought for with avidity. This must be greatly gratifying to Prof. Paine, who, with far-reaching foresight, saw very clearly that a system of medical philosophy, based on the laws of the inorganic world, could not stand when brought to the test of observation and experiment. On reading the 'Institutes,' we can not but be struck with the admirable consistency of the author's views throughout the entire work. The same principles, the same philosophy form the foundation and substratum of the whole. There is no inconsistency, no contradiction, not even the shadow of any clashing throughout. Taking up each topic in its natural order, as each successive one emanates from, or depends upon, the preceding, there is a lucid order every where displayed—a chain, with no broken link. As in a mathematical demonstration, each step prepares the way, and is necessary for the succeeding. The demonstration proceeds with logical exactness and unbroken sequence, till the conclusion rests on a basis impregnable as truth itself.

"As the author truly remarks, this is the first effort that has been made to present the natural relations of the whole subject of the institutes of medicine, including physiology, pathology, and therapeutics in their just order—to point out the affinities, and to exhibit throughout the important laws and essential foundations of vitalism and to maintain throughout a consistency of facts and of laws that shall stamp the whole as the *philosophy of medicine*. This has been most successfully accomplished; and the zeal, learning, and genius displayed in its accomplishment will forever stamp the author as a leading spirit in our profession—as one of the great masters in our art. If the work bear something of a controversial aspect, it was unavoidable in carrying out the great design of the writer. A simple expression of facts, of experience, and of philosophical doctrines, would not have sufficed. It was necessary to expose and refute the errors with which the subject was environed."

In an extended analysis of the work, the reviewer enters upon the author's original views of the nervous system, and more specifically as to the "excito-secretory system," showing that even the term itself was derived from writings of his as early as 1842, but that he regarded it as only a small part of the influences exerted through the same system of nerves, and quotes the author extensively to this effect. "No one," says the Reviewer, "can read Dr. Paine's Institutes without being satisfied that '*excito-secretory*' is every where comprehended in what is set forth as to the general organic influences of reflex action. The grand doctrine is again and again reiterated in every part of the work, as on page 601," &c.

"It is not too much to claim for our author and countryman that, with unsurpassed acumen and ability, he has abundantly established the fact that secretion in animals is conducted by powers implanted in every part, but that it is constantly influenced physiologically, pathologically, and therapeutically, by reflex action of the nervous system."

From the Southern Medical and Surgical Journal, Augusta, Ga., August, 1858.

"Of all American writers none has been more indefatigable and laborious than Professor Paine, and the works of but few, either in this country or in Europe, display a greater amount of learning than we find enriching both the Institutes and Commentaries of this perhaps most recondite of American authors. On opening any of his works we may be said to be at once 'lost in a sea of erudition,' and his copious references to the authors of every country and every language attest his familiarity with the general literature of the science. * * In an age when Humoralism and Organic Chemistry are threatening to displace all other views of physiological and pathological action, this work, *because* it is *ultra* in its vitalism and solidism, must exert a most salutary influence upon the history of the medical opinion of the present and the rising generation. It requires no half-way assertion of the power of nervous action to gain its admission; but he who would advocate its unmodified sway, as Dr. Paine does, must be as firm and uncompromising as he has been throughout the comprehensive work before us. The present edition has been prepared, apparently with great care. A most copious analytical index much enhances the value of the volume, and attests well the perseverance and industry of the author."

From the Memphis Medical Recorder (Tenn.), March, 1853.

"All praise, we say, to those pathologists, with Professor Paine at the head of them, who so long and so ably kept alive the anticipation that it was through the reactions of various departments of the nervous organization, one on the other, that pathological and physiological sympathy resulted. * * In America no earlier or more sedulous laborer in this field can be pointed out, as we think, than Professor Paine; whether discussing the principles of pathology, or physiology, or therapeutics, it has been the distinguishing merit of this writer always to keep steadily before his mind the probable influence of reflex nervous action in the production of the phenomena he may be treating of. * * Especially has he acquired well-won laurels by the use he has made of this principle in the controversy with the mere chemical theories upon which the influence of Liebig was leading men to ground all explanations of vital or even mental processes."

From the Nashville Monthly Record (Tenn.), September, 1858.

After commending the Medical and Physiological Commentaries, Professor Wright remarks that:

"It is in the Institutes of Medicine that the great principles of vital physiology and pathology are broadly and systematically stated. It would be impossible for us, if we had much more space than we have, to give any thing like a satisfactory analysis of this profound and inestimable work. We will only say that if our whole system of medical philosophy has escaped being overwhelmed by the confident dogmas of the chemical school; if we have learned to look for perverted forces rather than vitiated material in pathology; if our younger writers see more of the nerves in diseased and healthy action and less of ferments and catalyses than they did a few years ago, then he who desires to assign the palm to him who wielded the sword while there were none to stand by him, should cast a glance back at the Commentaries and Institutes of Martyn Paine before pronouncing his decision."

From the Nashville Journal of Medicine and Surgery, July, 1858.

"The Institutes of Medicine, the Medical and Physiological Commentaries, and Essays on Vitality and Remedial Agents, are the titles of some of the works which have obtained for Dr. Martyn Paine the well-earned name of the great New York Physiologist. The first of these is a work of no ordinary merit, filled with the marks of profound scholarship and genuine philosophy, covering the entire field of medicine, and teaching it as a harmonious whole. * * We can confidently recommend the Institutes as a treasury of learning and invaluable Cyclopædia of medical knowledge, well calculated to lead the student into paths of logical instruction and habits of sound reasoning, as well as instructing him in medical science."

From the New Hampshire Journal of Medicine, July, 1858.

"It would be impossible to review this immense book in less than one hundred pages. It is a monument of the learning and industry of its author, and is full of valuable facts and profitable suggestions."

The August Number of the same periodical copies from the *Virginia Medical Journal* an able, elaborate, and thorough defense of Dr. Paine against the misrepresentations of an English Reviewer, with the following prefatory remark: "No apology is necessary for occupying our pages with this long article. The justice of the views here expressed, both in relation to Dr. Paine's works and the English reviewer will be apparent to all."

From the Atlanta (Ga.) *Medical and Surgical Journal*, September, 1858.

"In these works (the Institutes, Commentaries, &c.), are embodied the views of one of the most laborious and learned medical philosophers of this or any other country upon the complicated theories in physiology, pathology, and therapeutics, in reference to the great principles and laws of organic being. * * We commend their contents in the most decided manner, as in the highest degree worthy of the most thorough investigation. * * Notwithstanding, however, our great respect for the author of these works, we do not desire to be understood as committing ourselves to his views, being, as he is, the peculiar defender in this country, of what we conceive to be (as we understand them) the erroneous doctrines of Solidism and Vitalism."

From the College Journal of Medical Science, Cincinnati (O.), July, 1858.

"However much we may differ with the author upon some points, we feel that the *Institutes* contains a mine of knowledge within itself, and bears the imprint of the close student and original thinker. We think, in recommending the book to our readers, that we are conferring upon them a personal favor."

From the Oglethorpe Medical and Surgical Journal, Savannah (Ga.), June and August, 1858.

"This work enjoys celebrity among the graduates of the University of New York, and has been favorably received by the profession generally."

The same journal says of Dr Paine's *Medical and Physiological Commentaries* that "No work written in this country has fallen under our observation, to which the terms *learned* and *able* could be more appropriately applied than to this production of the mind and pen of its accomplished author."

From the New Orleans Medical News and Hospital Gazette, July, 1858.

"In our last number (which we have not seen) we noticed Professor Paine's *Institutes of Medicine*. We have now to make our acknowledgments of the foregoing valuable works (the Medical and Physiological Commentaries, and Essays on Vitality and Modus Operandi of Remedies), which are most welcome to a place in our library. We only regret that the size and objects of this journal preclude our giving a more extended notice of the whole of these valuable works."

From the Peninsular Journal of Medicine and Collateral Sciences, Detroit, March, 1858.

"We bespeak for this enlarged edition of the *Institutes of Medicine* a hearty reception and a studious reading."

From the Cincinnati Lancet and Observer, October, 1858.

"No name in American Medical Literature occupies a more prominent or worthy position just now than that of Professor Martyn Paine; no works have been reviewed in our medical journals which have exhibited such profound learning, such industry, such extended research. The works, whose titles are given above (The *Institutes, Commentaries, and Essays on Vitality and Remedial Agents*), embrace a period of almost twenty years, from their first to their last dates of publication, and the most superficial reader can not but bear witness to the singular unity of design in the entire series of works, as well as to their careful maturity, for which so few medical writers of the old or new world have labored, and to which so few arrive. This testimonial to the genius of Paine, in which the medical press of America so cordially unite, is the more memorable when we call to mind the obstacles which he has encountered, the elements of opposition through which he has advanced to such honorable position. Twenty years ago the mechanical and chemical doctrines of physiology, whereby it was sought to abandon the idea of a distinct *Principle of Life*, were largely adopted by leading philosophers of the world; but, in the very face of those prevailing doctrines, Paine became at once, always—and always consistently—eminently the champion of vitality and solidism. These two ideas are the fonndation and key-stone of all his views. He had the wise foresight to anticipate that the prevalent opinions of twenty years ago were unstable; and though slowly working his way onward and upward, his ultimate triumph has proved the highest tribute to his genius and scholarship."

"To the laborious thinking student of medicine every where we commend the writings of Martyn Paine."

From the Maine Medical and Surgical Reporter, January, 1859.

"Dr. Paine discusses (in the Institutes) with marked ability the points of difference between the vitalists, of whom he is the most distinguished exponent, and the chemical physiologists."

"The arrangement (of the subjects) is philosophical, and, if we admit the premises of our author, we are forced by his admirable and logical reasoning to admit the correctness and truth of his conclusions."

From the Peninsular and Independent Medical Journal, Detroit, Michigan, February 7, 1859.

"We may safely say that this work (the *Institutes of Medicine*) is not second to any one of the kind in the language, if any can be found of equal merit."

"A profound and methodical thinker and an erudite philosopher, Dr. Paine has shown consummate skill in presenting his favorite and truthful theory of *Vitalism*, as opposed to the chemical and mechanical doctrines of life."—N. D. S.

From the New York Medical Press, January 22, 1859.

"This elaborate work (the *Institutes*) displays in every page the profound learning, immense research, and sound philosophy, of the venerable and distinguished author. It is, at the same time, a triumphant refutation of the false doctrines of materialism, and other kindred theories."

From the Pacific Medical and Surgical Journal, San Francisco, California, December, 1858.

"Is there a science of Medicine? We think there is, but it is, like the tomb of Moses, unknown to this day." "The facts exist; but they are not acknowledged by all; they are not classified," &c.

"Our author has attempted, in these *Institutes*, to give the philosophy of medicine. He has succeeded in giving more of the true philosophy of medicine than has ever before been given in any work. There is order, sequence, and harmony to an eminent degree in this work. It is an edifice, and though not an Egyptian pyramid, it is still a magnificent structure, which few men in our profession could make in greater perfection, or in more ample proportions."

From the Medical Journal of North Carolina, April, 1859.

"These are works (The *Institutes of Medicine* and the *Med. and Physiolog. Comm.*) of vast research, of the most extensive erudition, and of wonderful ability, reflecting the greatest credit on their author, his country, and the profession of which he is a member. They embrace, in fact, the whole arcana of medical science, containing full expositions of every department included in the professional curriculum, presenting learned and erudite treatises on all topics of interest to the physician, and offering so wide a field for contemplation and study as to fill us with surprise that one man could have accomplished so much. There is an unpretending simplicity in his style, too, which is very pleasant and attractive, especially in these days of bombastic inflation and pedantic superfluities. In fact, Dr. Paine's works are a success, and not even the most carping critic can deny the fact without proving himself too ignorant and malicious for his office. As regards the great subjects of 'solidism,' 'humoralism,' 'vitalism,' &c., which are so extensively discussed in these books, we have neither the time nor space to consider them at present, but can only say that Dr. Paine sustains his views with wonderful plausibility, erudition, and ability. No physician should esteem his library complete until these three admirable works have been added to it, not as a mere ornament or for the name of the thing, but to be studied carefully and continuously, as well as in that spirit of exultation which the pre-eminent success of a fellow-countryman must engender in every patriotic bosom."

From the Baltimore (Md.) *Journal of Medicine.*

Professor F. Warren, M.D., the editor, remarks that "Dr. Martyn Paine is, by all comparison, the most able and erudite of American authors, and the special champion of those great doctrines of Vitalism and Solidism, to the advocacy of which we stand at all times committed."

From the Cincinnati Lancet and Observer, September, 1868.

"The magnificent achievement before us contains the labor and brains ordinarily spread over the construction of a whole library of medicine." "We know of no book in our language which gives evidence of such extended learning."

From the Detroit Review of Medicine and Pharmacy, July, 1868.

"The volume is a library of philosophical and practical medicine." "The Doctor's Note, *Rights of Authors*, settled the question. The work will stand the test of time like the old granite hills of New Hampshire. It can never meet with any successful opposition.—N. D. S."

NOTICES BY DISTINGUISHED

NON-PROFESSIONAL JOURNALS.

THE Physiological Articles in this work having attracted attention beyond the limits of the profession, the following extracts from Notices are selected from distinguished journals which are not medical, but in which the Notices were evidently written by those who had studied the work, and which, therefore, embody public opinion.

From the North American Review, April, 1863.

"This work covers the entire ground of physiology, pathology, and therapeutics, and, logical in arrangement, minute in subdivision, affluent in references to other books, and continually referring back and forward to its own pages, it constitutes an admirable system of medical science. This were ample praise. But in addition to this, the successive subjects are treated by Dr. Paine with great conciseness, indeed, but with great vigor and earnestness, with frequent originality, and in a style which shows that, when his opinions coincide with those of others, they are yet his through the independent action of his own mind. Then, too, if he agrees with no one else, he is uniformly consistent with himself, his conclusions following legitimately from his premises, and his views on allied departments of science or art bearing tokens that they belong to the same system, and rest on parity of reason."

From the Methodist Quarterly Review, April, 1863.

"Of the two great schools, namely, the Chemical and the Vital, Dr. Paine is a leader if not the head of the latter." "From the high character of the chemical theorists, and the plausibility of their pretensions, they seemed, for a while, to carry with a rush every thing before them. Medical science was thus tending to a system of low theoretic materialism. Against this torrent Professor Paine has stood firm as a column of adamant." "Whatever may be his peculiarities of belief, all parties must bear testi ony to his learning, genius, individuality, and pure independence of mind."

From the American Quarterly Church Review, April, 1863.

"In the Appendix the Author attempts to demonstrate the substantive existence of the Soul and the Instinctive Principle upon physiological grounds. The demonstration is exceedingly able, and refutes effectively, we think, the materialism of the day, by which infidels would rob the soul of its immortality."

From the Boston Review, March, 1863.

"Its strong points are a broad and thorough treatment of the whole science of physiology, pathology, and therapeutics; a sturdy conviction of the soundness of its positions; a clear understanding of the opposing theories; and a vigorous, classic, concise, and unflinching style of writing."

"In a labored supplementary dissertation he contends with great cogency for the distinct existence and immortality of the soul, against the materialists and all who, confounding reason with instinct, push us downward toward annihilation."

From the New York Evening Post, August 8, 1863.

"Dr. Paine's works are of the highest order of medical scholarship. The volume before us requires no praise. It is a most valuable magazine of therapeutical sciences, containing, as it does, the results of thorough investigation which are here carefully digested and applied. The learned author discards utterly any dependence upon organic chemistry for the prosecution of physiological or pathological research, and proves his positions by quotations from Lehmann.

"The most curious chapter, for metaphysicians, will be found in the Appendix, where Dr. Paine has embodied an essay on the 'Soul and Instinct, physically distinguished from materialism.'

"Many of the positions taken by Dr. Paine are original with him. He is a physician of extraordinary attainments; and his works have been liberally copied from at home and abroad."

From the New York Daily Times, February 7, 1863.

"Professor Paine's *Institutes of Medicine* are based on broad and prominent principles of Nature." "'Solidism and vitalism,' the book opens, 'will form the basis of these Institutes;' and to the elucidation of these time-tried doctrines, and to their defense against Chemical Philosophy and kindred neologisms, he brings the results of long and severe investigation and eminent knowledge. He does not scruple to enter the lists and try his lance against the glittering armor of LIEBIG and HUMBOLDT, and it is apparent to every one that the blows are well aimed, and the weapon impelled by a stout arm, guided by a clear eye, with a vigorous brain behind it." "We do not pretend to commend the work to the Profession. It is already thoroughly appreciated there. But there are now such a large number of non-professional students and investigators in this field of research that we wish to call attention to this new edition of a standard professional book." "In a very entertaining chapter on the 'Rights of Authors,' in which Professor Paine dissects the claims of those who pretend to have antedated him in the discovery of some valuable principles, and in the statement of some important theories, he clearly shows his priority in research, discovery, and promulgation of the doctrines in question."

From the Taunton (Mass.) *Gazette*, February, 1863.

"This massive work is alike remarkable for the range of its learning and the vigor of its logic. We feel, as we read, that Professor Paine is not only vast in his sweeps, but unerring in the return of his curves. As an inquiry into what is so far known of the treatment of diseases as to have been demonstrated by long and enlightened practice, this elaborate work is most thorough in its array of facts, and singularly vigorous in its reasoning. It is emphatically a student's book; and yet no one capable of drawing an inference from premises, and of understanding how premises should be established, can read these 'Institutes' without growing in wisdom on the subject, if he do not find cause to cast out some crude and perilous opinions which he had previously entertained. Certainly, so antagonistic are curative theories, that it behooves every man to inquire for himself; and nowhere can he look with more satisfaction for the legacies which all the ages have bequeathed to the healing art than in this volume."

From the Philadelphia Presbyterian Standard, February, 1863.

"Dr. Paine does not do himself justice, as this, instead of the seventh, is really the eighth edition of his great work."

"After twenty years' acquaintance with the schools of Edinburgh, Dublin, London, and Philadelphia, we feel warranted in saying that we have seldom met with any single work that is better calculated to stimulate an active mind that is really and earnestly engaged in the pursuit of medical knowledge than in this work of Dr. Paine now before us. Dr. Paine grasps every subject with the hand of a giant." "The student who masters this book, if he have a capacity to comprehend demonstration, will never confound our material organization with that which dwells within it."

"We commend this really learned, manly, and wonderously suggestive treatise to all our young medical friends; and in order that some hundreds of them may know our estimation of its value, we shall take care to have this, our judgment of its merits, made known to the medical schools of this city."

From the American Presbyterian, Philadelphia, 1863.

In a second notice of the seventh edition of the Institutes, the writer says that: "A careful examination of this work shows the author to have a fine mind, highly cultivated, and ardently devoted to the advancement of his profession. He seems to have read and carefully digested almost every thing of value written upon it. Truth is ever the object before his mind, and while he states his own opinions strongly, we admire the fairness with which he presents the views of those opposed to him." "The principles of the work will be a safe guide to the active physician, and may be trusted in cases of doubt and danger."

From Zion's Herald and Wesleyan Journal, January, 1863.

"We commend the 'Institutes' to physicians and to scholars of all professions. It should be in every public library."

"The arguments to show from physiology that the mind is a spirit, and the revelation of its immortality is reasonable, are original and profound, and very strongly expressed."

From the New York Observer, January 7, 1863.

"The medical student makes the Institutes of Medicine his text-book, and every intelligent person who reads it with attention finds a field of knowledge opened up to his mind that constantly furnishes him most important and useful instruction. It is often said that when a man begins to read medical books he imagines himself the victim of all the diseases he reads of. Such a philosophical work as this will not leave him liable to an evil like that, but he will learn those great principles on which health and life depend."

From the New York Sunday Times, January 11, 1863.

"Dr. Paine's discussion of the vital principle and its properties will deeply interest many a reader besides medical practitioners and students, and his whole treatment of the subject of organic philosophy will be found at once able, eloquent, erudite, and full of remarkable originality." "Physiology, pathology, and therapeutics, with all their relative branches of study, are elaborately treated in these 'Institutes,' and an extraordinary amount of information is given on the subject of physiological and pathological chemistry, the production of animal sugar, the absorption and circulation of plants," &c.

From the New York Evening Express, January 10, 1863.

"A most valuable book the 'Institutes' must be for the practical physician, as well as a most amusing and instructive one for the general reader."

From the New York Christian Times, January 22, 1863.

"Criticism is not the thing required in respect to this learned and philosophical volume. It is sufficient that we call attention to this as the seventh edition of an *opus magnum* of the highest authority among medical men. Its author is both known and honored as the patriarch of American physicians, and as a savan of whom the profession is justly proud."

From the New York Commercial Advertiser, January 13, 1863.

"This seventh edition of the 'Institutes' is the author's legacy, more valuable than rubies, to his brother physicians and their successors. Successful will he be who studies and follows its teachings."

From the Congregationalist, Boston, January, 1863.

"The Institutes of Medicine is an invaluable repository of scientific information and a lasting monument of the author's industry, skill, learning, and genius. He enters on his work with the facility of an adept and the vigor of an athlete. Entertaining a lofty scorn of empiricism, he slowly gathers fact on fact, piling them up into a firm foundation for the temple which he would rear, whose solidity, proportions, and effect, we can not fail to admire." "To his opponents, as well as to his adherents, the book must be of an inestimable value. Symmetrical in plan, exhaustive in detail, clear in style, devoted in spirit, it is at once suggestive and satisfactory."

From the Christian Intelligencer, New York, February, 1863.

"The 'Institutes' is a monument of learning; and the reception it has already had is no empty promise of the wide and lasting influence it is yet to exert."

From the Chicago (Illinois) *Journal*, February, 1863.

"To the unprofessional reader the essay on the Soul and Instinct, in which the substantive existence of the former and the principle of the latter are demonstrated, is one of abounding interest. Materialism will find many difficult problems to solve in the erudite and scientific arguments of the Author."

From the Maysville (Kentucky) *Eagle*, February, 1863.

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COMMUNICATIONS TO THE AUTHOR.

As an example of letters which the author continues to receive, we submit the following extract of a letter from the eminent Von Dr. Professor N. Zdekauer, Physician to His Majesty the Emperor of Russia, dated St. Petersburg, April 19, 1867.

"Your valuable works are very often studied by me, and I look on them as on an Enchiridion of Medical Science and Philosophy. How wise and practical are your chapters on the Remedial Actions, on Sympathy, and all the chapters on Pathology! But your greatest merit is to have in a most rational manner treated about Vital Principles and Powers, contrary to the most material and dead-born tendencies of the newest authors."

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WORKS BY DR. PAINE.

I.

Medical and Physiological Commentaries. Octavo. Vols. I. and II., 1840; pp. 1531. Vol. III., 1844.

II.

Institutes of Medicine. Octavo. First Edition, 1847. Ninth Ed., 1870; pp. 1151.

III.

Materia Medica and Therapeutics. 12mo. First Ed., 1848. Third Ed., 1859; pp. 411.

IV.

On the Soul and Instinctive Principle, physiologically distinguished from Materialism. First Ed., 1848. Third Ed., Octavo, 1871, of about 600 pages; will soon be published.

V.

Memoir of Robert Troup Paine. 1000 copies, illustrated; Quarto; pp. 524. One copy, folio, for the library of Harvard University; privately printed, 1852.

VI.

On the Cholera Asphyxia of New York. Octavo. 1832; pp. 160.

VII.

On the Philosophy of Vitality, and on the Modus Operandi of Remedial Agents. Octavo. 1842; pp. 70.

VIII.

Experiments to ascertain whether the quantity of Blood circulating in the Brain may be reduced by Bloodletting. Published originally in the *Medico-Chirurgical Review*, London, 1834.

IX.

On Theoretical Geology, sustaining the natural interpretation of the Mosaic Narrative of Creation and the Flood, in opposition to the prevailing geological hypotheses. Octavo; pp. 121. Published originally in the *Protestant Episcopal Quarterly Review*, New York, April, 1856.

X.

Organic Life as distinguished from the Chemical and Physical Doctrines. 12mo. 1849; pp. 53.

XI.

Examination of Reviews. Octavo. 1841; pp. 96.

XII.

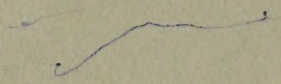
Physiology of Digestion. Octavo. 1844.

XIII.

Defense of the Medical Profession of the United States. Octavo. 1847.

XIV.

Essays and Reviews in Medical and other Periodicals, among which are seventeen articles showing the superiority of Medical Education in the United States over that in Great Britain, founded upon Parliamentary Documents, and which appeared editorially in the New York *Medical Press* from Jan. 29 to June 4, 1859.



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